

## ABSTRACT

Title of Thesis: BUILDING EDUCATION: CREATING A FLEXIBLE MODEL FOR SUSTAINABLY DEVELOPING COMMUNITIES IN LATIN AMERICA

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Latin America has a deep-rooted history with issues of poverty. Education is a vital part of the solution. Education and increased literacy can help communities break away from a cycle of poverty by opening doors and creating opportunities for independence. Many impoverished countries in Latin America rely on the cultivation of primary products to sustain their economies. Unfortunately, the high number of illiterate and untrained laborers in these parts of the world halts their progress. These are recurring issues in many underdeveloped countries.

Rural communities tend to be deprived of resources and this leads to an exodus of the young as they are looking for opportunities for growth. They leave their villages and don't always come back having completed a full education.

This thesis intends to create a model for an educational facility that can be applied to multiple contexts, with an effort to empower communities through providing

education for children to achieve their full potential, and for agricultural workers to heighten their knowledge about the trades that affect their livelihoods directly

Research will explore modular design as a means to cater to the diverse contexts with a changing demand and whether a possible model can be self-sustaining. It will also explore how a building can bring a community together.

Could a deployable model be effective cross culturally?

Can flexible design help mobilize a struggling community?

How to create an environment that can be conducive to learning?

BUILDING EDUCATION: CREATING A FLEXIBLE MODEL FOR  
SUSTAINABLY DEVELOPING COMMUNITIES IN LATIN AMERICA

by

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## Introduction

The chapters to follow will delve into research that aim to explore how a deployable model of an educational facility can be a feasible and sustainable solution that can easily supplement the existing efforts that are being made to break the cycle of poverty in the Amazonian Region of Peru. This expansive area encompasses some of the poorest and least accessible parts of the country which has led to regions with the lowest levels of education in the country.

This paper will first look into the existing conditions of poverty in Latin America to understand the context in which the project is based, and how the state of education in Peru plays into the that larger cycle of poverty, with a brief look into some of the current global and regional efforts that are in place to resolve some of those issues. With an intent to hone in on some of the more immediate issues related to the sites selected, there will be an exploration of current conditions of educational infrastructure in the Amazon and of the climatic struggles of the region, with a look into current projects that are being implemented, with some critique of what may be missing.

The next portion of the paper is more centered on the spatial qualities of the thesis and explores different teaching methodologies in order to understand how the educational facility can best be laid out, with a look into the school as a typology, with the argument that a portion of the solution is to physically adapt the way in which schools are teaching. These chapters will also take a look at some design guidelines set forth by local governments for bio-climatic design of educational facilities based on their location. In response to those guidelines, a chapter will focus on sustainable

building practices with a look into vernacular architecture since the building methods are particular in this complex climate. Ensuing those chapters, this document will propose two sites as case studies for the deployable model, each with different characteristics, in the hope of proving that a flexible model can be adapted based on local needs, to empower and help Amazonian communities break from their existing cycle of poverty. This chapter is complimented with a look into architectural program as it has been derived based on explorations of precedents of other schools and how it has been influenced by the forces of the community and needs of the sites analyzed.

## Chapter 1: Defining the problem

### Poverty and Inequality

Latin America is widely known for its extensive issues of poverty and inequality and these are proven to be true. One out of three Latin Americans lives in poverty and 86 million people in this part of the world are struggling to survive on incomes of \$1 per day, or less.<sup>1</sup> Progress in the developing countries of this region is hindered due to these high levels of poverty. In addition to this poverty, there are high numbers of income inequality throughout this area, for example, in some areas the richest 10% of people have 84 times the resources of the poorest 10%.<sup>2</sup> Research suggests that the most important factor that is contributing to the persistence of inequality and the rise in poverty is the absence of adequate education and the disproportionate allocation of resources.<sup>3</sup> Income inequality has triggered large public support for university education, which unfortunately has deterred resources from basic education. With less resources, the quality of basic education has suffered and does not meet the expectations of the population. The rate of illiterate laborers, people who have reached the age of 25 and have not been educated or have not completed their primary education, is disproportionately increasing. The World Bank has come to the conclusion that only an increase in human capital development, which would be universal basic education for all, can actually bring the area out of poverty. Their research also leads to believe that education in itself can lead to higher growth rates for

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<sup>1</sup> Juan Luis Londono, "Poverty, Inequality, and Human Capital Development in Latin America, 1950-2025" (World Bank, Washington, D.C., 1996).

<sup>2</sup> Londono.

<sup>3</sup> Londono.



these countries.<sup>4</sup> One of the costs to pay by spending more time getting educated will be that young people will not be in the work force while they are getting their education, but this will benefit the labor force in the long run.

### Education

“One of the principal challenges in reducing poverty and accelerating development in Peru is improving the quality of education.”

-The World Bank

The current state of education in Peru is experiencing some issues, most of which relate back to basic issues of poverty and inequality, and there is a debate of how to improve the quality of education in the country. There are high levels of coverage, but low levels of quality. A lot of the enrolment that they do have takes place in infrastructure that is less than optimal.<sup>5</sup> The country is also experiencing difficulties with bilingual education and a proper gender balance.

### *Drop outs*

Completion rates in Peru are high for primary school children but only about 65% for secondary school. Research suggests that poverty and “economic reasons” are the key factors of the drop out behavior of the other 35%.<sup>6</sup> These economic reasons can relate to families’ inability to pay for school fees, student’s need to work, their need to help around the house as well as other factors related to poverty. The second most important reason for these drop-out rates are explained by family and health issues, many of which include pregnancy. This same research suggests that the school’s quality

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<sup>4</sup> Londono.

<sup>5</sup> Ibid., xiii.

<sup>6</sup> Ibid., 62.

and relevance are the third most important factors, where schooling is not seen as useful. This is reflected in the high levels of illiteracy from parental and grand-parental generations.<sup>7</sup> Socially there needs to be given a higher importance to education, and this unfortunately is part of the paradoxical problem. At a more international level, we see that 1 in 4 girls in developing countries is not in school, giving us a sense of the gender inequalities, giving us a sense of the urgency of the gender inequality prevalent in education.<sup>8</sup>

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<sup>7</sup> *Toward High-Quality Education in Peru: Standards, Accountability, and Capacity Building.*

<sup>8</sup> United Nations, “Sustainable Development Goals: Quality Education,” 2015, <https://www.un.org/sustainabledevelopment/education/>.

Explicit reasons for dropping out,  
as provided by dropouts (respondents  
aged 6–25 who were not in school and  
had not finished secondary school)

	Rural	Urban	Total
1. Military service	0.5	0.5	0.5
2. Working	10.6	24.9	16.1
3. No adult learning center nearby	0.6	0.3	0.5
4. No school nearby	4.4	0.2	2.8
5. Not interested or don't like school	12.5	12.3	12.4
6. Illness	3.7	5.7	4.5
7. Economic problems	37.1	33.4	35.7
8. Family problems	18.2	9.9	15.1
9. Low grades or school failure	1	0.9	1
10. House work	9.6	9.1	9.5
11. Others	1.9	2.6	2.2
Summary reasons			
Economic (2, 7, 10)	57.3	67.4	61.3
School quality/ appropriateness/ interest (5, 9)	13.5	13.2	13.4
Family problems and health (6, 8)	21.9	15.6	19.6
No schooling facilities (3, 4)	5	0.5	3.3

Reasons for dropping out,  
women 15–49 not in school

	Rural	Urban	Total
1. Pregnant	10.1	13.8	12
2. Got married	7.4	5.3	8
3. Needed to take care of children	4.7	3.7	4
4. Family needed help	19.2	2.9	3
5. Could not afford school fees	15.8	20.4	20
6. Illness	2.4	2.0	
7. Needed to earn money	9.7	26.1	17
8. Graduated/felt sufficiently educated	2.6	8.3	6
9. Failed entrance exams	0.9	2.2	2
10. Did not like school	14.2	6.1	10
11. School or teachers unavailable	6.1	0.7	2
12. Other or NA	6.8	8.6	11
Summary reasons			
Economic (5, 7)	25.5	46.5	37.0
School quality/ relevance (8, 9, 10)	17.7	16.7	18.0
Pregnancy and other family reasons (1, 2, 3, 4)	41.5	25.7	27.0
No schooling nearby (10)	6.1	0.7	2.0

Figure 1: Quantitative Evidence on School Dropping Out (by The World Bank)

### Language

Studies show that student's native language is a significant determinant of learning achievement, following the issues of proper school management and poverty.<sup>9</sup> Difficulties of intercultural bilingual education stem from linguistic and cultural discrimination that are prevalent in Peru, along with an absence of attentiveness to pedagogical development of the poor.<sup>10</sup> This type of inequality is unlike most in Latin American countries, since it cannot be explained in economic terms. Little is known about how to handle this issue, but it is something that has to be taken into account when designing equitable spaces. About 26% of children speak a language other than Spanish as their native tongue.<sup>11</sup> This impacts teaching greatly and not all schools are equipped or have adequate teaching pedagogies for this scenario. This large number means that bilingual education should be given importance in Peru. Another factor that should also raise its importance is that there are studies that prove that there are significant connections between students having Spanish as a first language and their achievement in school. The World Bank's findings suggest that there needs to be more parental and community support in order to have successful inter-cultural and bilingual education, which can have spatial implications in schools. Even though 84% of Peruvians speak Spanish, the country's official language, there are about 150 aboriginal languages spoken in the Amazon forests by the native populations still residing there.<sup>12</sup> This will be particularly prevalent when designing in this region.

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<sup>9</sup> Ibid., xiv.

<sup>10</sup> Ibid., xiv.

<sup>11</sup> *Toward High-Quality Education in Peru: Standards, Accountability, and Capacity Building*.

<sup>12</sup> World Atlas, "Aboriginal Languages of Peru," n.d., <https://www.worldatlas.com/articles/what-language-do-they-speak-in-peru.html>.

### *Spending*

Spending is another prevalent issue for education in Peru. Education only makes up 3% of the nation's GDP, which is low in comparison to other neighboring countries.<sup>13</sup> Public spending is not necessarily preferential, or is actively targeting the education of the poor, even though the poverty headcount for the regions of study of this thesis are as follows: Cajamarca 73%, Junín 51%, and Loreto 66%.<sup>14</sup> The ultimate benefit for the poor from education is not related to the amount that is spent on them but rather the increased life chances that they are getting and the options that they will experience in the labor market from that investment.

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<sup>13</sup> *Toward High-Quality Education in Peru: Standards, Accountability, and Capacity Building.*

<sup>14</sup> *Ibid.*, 40.

Region	Primary	Secondary	Poverty headcount
Amazonas	639	993	61%
Ancash	713	1,194	54%
Apurímac	633	821	68%
Arequipa	776	1,081	42%
Ayacucho	695	948	65%
Cajamarca	618	890	73%
Callao	526	880	41%
Cusco	550	697	56%
Huancavelica	622	943	82%
Huánuco	533	779	78%
Ica	682	916	26%
Junín	596	890	51%
La Libertad	568	893	50%
Lambayeque	514	784	49%
Lima	631	947	37%
Loreto	626	872	66%
Madre de Dios	795	1,014	21%
Moquegua	1,178	1,437	39%
Pasco	645	1,065	61%
Piura	548	766	60%
Puno	722	933	57%
San Martín	653	905	29%
Tacna	776	1,324	25%
Tumbes	1,081	1,739	55%
Ucayali	506	846	61%

Figure 2: Per Student Spending and Poverty Levels by Region, 2003 (by The World Bank)

### Current efforts to improve (Sustainable Community Development)

“Achieving inclusive and quality education for all reaffirms the belief that education is one of the most powerful and proven vehicles for sustainable development.”

-United Nations

There are entities that globally and locally are trying to tackle some of these issues of poverty, inequality and quality education. The United Nations General Assembly, for example, set a list of 17 goals, the Sustainable Development Goals (SDGs), in 2015, that range from eliminating poverty, to improving the quality of

education worldwide. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has taken on their Sustainable Goal 4 (SG 4) which deals with quality education. They agree, what research has proven, that superior quality education becomes a favorable factor for development and national competitiveness.



*Figure 3: Sustainable Development Goals (by the United Nations)*

In an effort to work towards their SG 4, UNESCO has launched a new program in Peru, called HORIZONTES (Horizons), on December 4<sup>th</sup> 2018. It is a program for Rural Secondary Education that will be developed in the regions of Ayacucho, Amazonas, Cusco and Piura, some of the regions with the highest conditions of poverty and inequality and is said to be one of the most innovative educational programs that deals with territorial and cultural identity. The program intends to prepare students to finish high school with a wider range of opportunities by providing them with a bilingual education and helping them respect their cultural identity.

“To be competitive in our country is to consider the potential of our cultural diversity, and to preserve and efficiently use our natural resources ... it’s not only a vision with

mere economic goals, it includes taking into account the value of the culture that makes up our country.”

-Peru's National Council of Education

Locally some efforts can be seen through Peru's National Council of Education (CNE for Consejo Nacional de Educacion) and their Ministry of Education (MINEDU) as they express their urgency to create a new educational horizon in their new National Educational Project for 2021.<sup>15</sup> With this new law the country intends to tackle some of the challenges that the country and its citizens are facing in terms of development. Their vision is for everyone to be able to develop their potential since early childhood, to have access to the literary world, to be able to resolve issues, to put into practice their values, to know how to keep learning, to self-identify as citizens with rights and responsibilities, and to be able to contribute to the development of their communities and of the country, while combining their cultural and natural capital with global advances.<sup>16</sup>

In order to achieve this quality education, we must look at successful teaching methods. The World Bank has identified a direct correlation between schools and communities and has looked at *Fe y Alegria* (FyA, Faith and Happiness in Spanish) as a successful school system that can be applied as a model of effective and autonomous oriented schools that provide direct service to the community. These are Catholic-oriented public run schools that are managed by the *FyA* system and are part of a large international movement, that aim to positively impact poorer children through an education that is academically strong and that is focused on christian values, which are

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<sup>15</sup> Consejo Nacional de Educacion, “Proyecto Educativo Nacional al 2021: La Educacion que queremos para el,” 2007.

<sup>16</sup> Ibid., 13.



greatly valued in Latin America. It is an approach that has been running since 1955 in Venezuela and has proven results higher than of regular public schools.<sup>17</sup> The World Bank proposes this as an option to help improve educational systems in Peru.

These are only some of the possibilities of improving the educational state in Peru. The next chapter will take a more focused look into the conditions of education in Peru's Amazonian region and what the current efforts are to improve it there specifically.

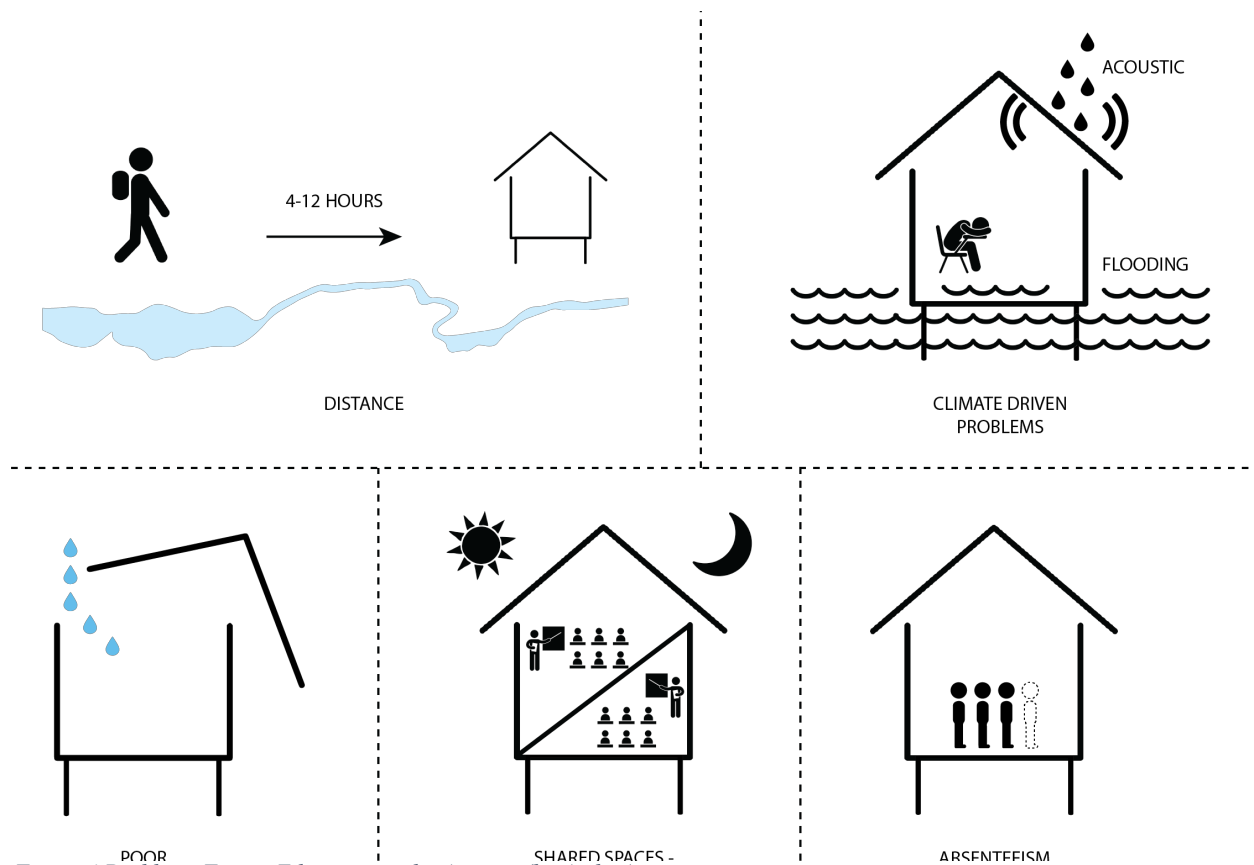
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<sup>17</sup> *Toward High-Quality Education in Peru: Standards, Accountability, and Capacity Building.*

## Chapter 2: Current Conditions of Educational Building Infrastructure in the Amazon

### Conditions in the Amazon

Even though education in Peru has improved in the past years, it still has a long way to go. Not everyone has access to education of quality. Unfortunately, it is still true today that your place of birth, your family's financial resources, and your native language, all influence greatly the opportunities you are going to have in life, even more so, in the jungle where educational levels are considerably lower than in the rest of the country. In order to get a full picture of the problem we must look at particular



conditions of the Peruvian Amazon as well as the reality of the current state of the infrastructure of public educational facilities in this region.

The Peruvian Amazon represents 61.09% of the country's terrain, with a total of 785 202 km<sup>2</sup> (about 194 acres). A system of rivers runs through this territory and connects populated areas dispersed along its' riverbanks. Commuting in this region takes longer and is more dangerous than in other parts of the country. Teachers and students take on average five and a half hours to go from a region's capital to schools.<sup>18</sup>



*Figure 5: Zones of Peru (by Author)*

### Distance

About 14% of schools in the Amazonian region have an average commute for students and teachers from their community to a larger regional capital that ranges from 4 to 12 hours, and about 2 days for the more remote areas.<sup>19</sup> This creates the need for

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<sup>18</sup> Jaime Saavedra Chanduvi and Arkinka, "Plan Selva: Infraestructura Educativa en la Amazonia Peruana" (Ministerio de Educacion del Peru, August 26, 2016).

<sup>19</sup> Chanduvi.

an architectural intervention. In order to reduce the frequency of such strenuous commuting and improve the quality of life of teachers and students, both should have the option of residing on school premises or in the immediate vicinity. This thesis will consider this aspect strongly in creation of the architectural program for the educational facility.

### *Poor Infrastructure*

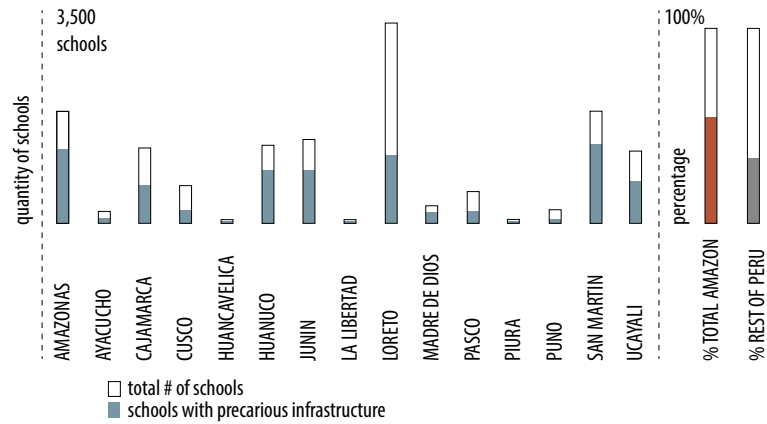
The challenging accessibility to these schools has led to a disinvestment, a lack of maintenance, and attention over time. Much of the Amazon's schools are in rural areas (74%), and only 14% are in urban ones, impeding easy access to basic services, thus influencing the site selections for this project, all within rural areas, or the peripheries of more populated regions. Due to their oftentimes isolated locations, only 15% of the schools have connection to public water, plumbing and electricity. Their lack of basic services and their distance results in their infrastructure being in a state of emergency. The disinvestment and abandonment from the state also has to do with the population dispersion found in the Amazonian region due to its expansive territory. Out of the 15,176 counted educational facilities in the Amazonian region, about half require renovations or a high level of structural reinforcements.<sup>20</sup> There are about 4,000 schools in remote areas whose condition is unknown.

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<sup>20</sup> "National Census of Educational Infrastructure" (Lima, 2013).

# 51.8%

## EDUCATIONAL INFRASTRUCTURE IN PRECARIUS STATE IN THE AMAZON



# 63.2%

## SCHOOLS WITHOUT ACCESS AND/OR ADEQUATE ACCESS TO BASIC SERVICES IN THE AMAZON (WATER, DRAINAGE)

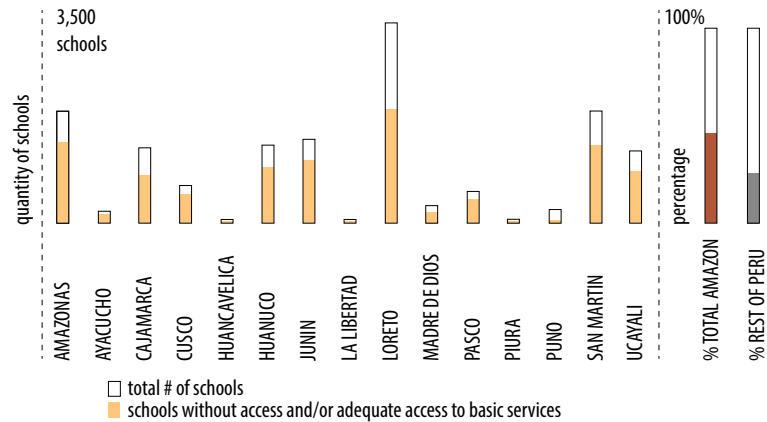


Figure 6: Schools in Precarious Condition and their Basic Services, By Region (by Author with information provided by MINEDU)

The attention that these facilities get can be categorized as some schools in the area requiring Total Repair and some Partial Repair. Schools that require Total Repair are those where all their classrooms have leaks and cracks in the walls and roofs. Partial Repair entails schools whose number of classrooms that have leaks and cracks are less than the total number of classrooms in the facility. Between urban and rural areas, rural

schools have more schools that require total repair. Most of the infrastructure that exists is not adequate to host educational activities, because of their poor conditions. Many of these schools were built as temporary structures by untrained community members, with wood walls, roofs out of corrugated iron or hay and rammed earth for the floors.<sup>21</sup>



*Figure 7: Current State of Educational Infrastructure in the Peruvian Amazon (Plan Selva)*

In the province of Satipo, out of the Regular Basic Education institutions, there are 67 elementary schools, 84 middle schools, and only 24 high schools. In the district of Satipo, there is an enrollment of 4,264 students in secondary school, with an average of 20 students per class. 31.2% of all schools in the Province require Total Repair, and in the town of Satipo, 18% of all public educational facilities need Total Repair, and

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<sup>21</sup> Semillas and Marta Anducas Armengou, “The Rural School in the Peruvian Amazon: Analysis of the Problem and Intervention Strategies in the Regions: Cajamarca, San Martin and Junin,” trans. Evelyn McCoy (Pangoa, 2015).

have classrooms with faulty roofs and walls. Only 11.5% of the Public Investment Project's spending is dedicated to fixing the structures that require full reconstruction in the Amazonian region because of the cost of taking materials to remote areas.<sup>22</sup> Very few schools have basic services such as electricity, potable water, and proper drainage, worsening the already fragile conditions in rural areas.

### Absenteeism

Another reality for many existing Amazonian towns is absenteeism. These distances lead to high levels of absenteeism for students as well as teachers, especially in rural areas. Absenteeism of students is also seen due to poverty. Many parents might be embarrassed to send their children to school as they do not have the proper supplies or adequate clothing. Not a lot of smaller villages have secondary schools and so in order for students to attend them in more populated regions they are required to board in these cities that tend to have higher prices than their small towns, and this leads to an additional financial burden for the families. Not all schools that receive students from remote areas have spaces to welcome their families for social gatherings.

In some cases, parents may not even elect to send their children to other towns because they need their kids to stay at home to help with farming, fishing and other lucrative activities and so keep them from attending school and completing their education. Many parents do not see the value of having their kids attend school, not being educated themselves, and prefer the immediate benefit that comes from their children working for the family. There is absenteeism from the part of qualified

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<sup>22</sup> Chanduvi, "Plan Selva."

teachers as well, most caused by a lack of consistent transportation. However, they also struggle with low pay. This greatly discourages them from journeying to remote areas and dealing with all of the other negative aspects of being in a remote area. A lot of young people teach as a way of working off the financial support that they might have received from the government in order to get educated themselves and in these cases, they do not choose the locations that they get sent to, and often end up in less favored remote regions. Many of these teachers might be from the city and feel lonely when they go these isolated areas. This project will need to take this situation into consideration and can use it as an opportunity to create spaces for these teachers to have to themselves and to socialize with other teachers in order to manage stress of being away from the city.

There are also strains on teachers from the impossible students-to-teacher ratio that dissuades them altogether. For some schools with few teachers and little infrastructure, they stagger different grades' classes between mornings and afternoons to make the most out of their resources. Some schools even double as community centers, where meetings are held, and events are hosted.

### *Climate*

Climatic conditions are another major consideration and in many of the current schools, an issue. The climatic region receives extreme precipitation, causing flooding issues when infrastructure is not well equipped, and acoustical problems when improper roof materials are chosen. Almost half of the existing schools are at risk of flooding. A successful educational facility has to respond to climatic conditions in order to protect and encourage students. Up until now educational infrastructure that has been



implemented has not responded to the context very appropriately, applying urban typologies to rural areas, ignoring the possibilities that the architecture itself could have to maximize learning. (stat about precipitation in region?) For cheaper alternatives and for quick construction, a lot of the schools are pre-fabricated and are not built with local materials adequate for Amazonian climatic conditions, many are short-lived materials. It is difficult to develop education when the conditions are bad: such as undesirable temperature, ventilation, and lighting.

### Current Efforts – Plan Selva

There currently is a national plan that intends to solve these issues at a local level. Plan Selva (*Plan Jungle*) is an educational reform created by the Ministry of Education of Peru in 2015 to improve the quality of education in the Amazonian region. Plan Selva adamantly trusts that a quality education is key for a developed country. Their plan is broken down into four parts; the revaluing of the career of a teacher, the improvement of teaching, a good management of the educational system, and a reduction in the gap of educational infrastructure. These are in line with the new politics and educational program goals in Peru.

This thesis intends to help with the Ministry's reform's 4<sup>th</sup> goal. Rather than focusing on giving everyone the same service, they want to tailor their approach and give everyone the service that they require based on their education need and location's requirements. In order to comply with this existing reform, the flexible education model developed through this thesis hopes to fulfill a need that can be manipulated and adjusted based on local needs. This thesis' goals align with this plan's goals to provide

a place where students can study with motivation, comfortably, and happy, taking into account the geographical, climatic and cultural context of where they are. This will lead to explorations of vernacular architecture of Peru's Amazonian region.

The country feels indebted to communities in remote locations that have been living with poorer conditions than the rest of the country and is intent on providing them with opportunities and services through their Plan Selva with an overall goal of achieving a sustainably developed country. The Plan wishes to guarantee basic conditions of habitability in educational facilities in the complex and previously abandoned area of the Amazon with an intention of increasing the knowledge index.

Through a kit of parts of infrastructure that fulfill pedagogical and climatic conditions of the Amazon provided by PRONIED (Programa Nacional de Infraestructura Educativa, or Ministry of Education's National Program of Educational Infrastructure), they would like to apply modular prefabricated systems, implemented in 5 steps: 1. Design and development of the mobile and prefabricated modular system, 2. Creation of a manual of educational infrastructure, 3. Implementation of the system, 4. Elaboration of the exterior, 5. Monitoring and maintenance by coordination of local governments.

Some downfalls of the Plan are that the involvement of the community is kept to a minimum. The Plan's strategies are very minorly centered around local users and at the extent that they do incorporate the community, they are dismissing the importance of integrating cultural identity through their processes. Architecturally, they propose pre-fabricated models without discussing the negative consequences that this option might introduce. They also advertise that they use local materials but

prioritize affordability and compromise in an area that could offer a lot of value environmentally, and socially.

Also important to consider is that here is a program called QaliWarma, that provides food services to students enrolled in public education, cater to indigenous populations of the Peruvian Amazon, done so to improve conditions in classrooms, because with healthy eating there is better attention, attendance, that promotes human development. The school would have to be designed to take full advantage of this program.

## Chapter 3: Teaching Pedagogies

### Traditional Teaching Pedagogy

Even though there have been many reforms and efforts to ameliorate the quality of education through improved access and coverage, there still remain challenges of attaining education that allows all students to develop to their full potential. This is the case because most of the reforms that have been passed are still focusing on traditional teaching pedagogies centered around a teacher rather than the student. Much advancement has occurred in humanity in the past century, and a lot has changed, but the way people learn and the spaces that they learn in have stayed the same in most countries around the world. We need a paradigm shift; a cultural shift away from simply transferring knowledge to actually understanding and constructing knowledge socially. In order to attain this we need to rethink the physical composition of the classroom, the programmatic relationships in schools, and the teaching methods applied.

In order to design the most effective school and learning spaces we must understand how students are taught traditionally, how people learn, what doesn't work,

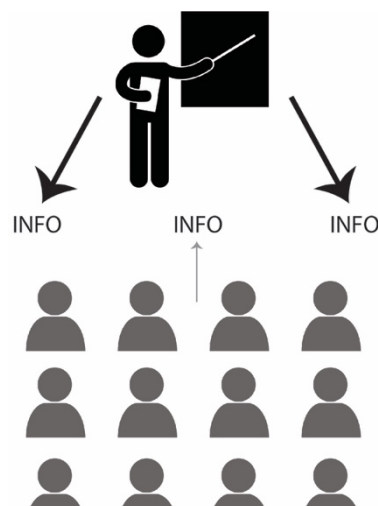


Figure 8: Traditional Method of Teaching (by Author)

and the ways in which teaching methods are changing to better address the needs of students.

The traditional way of teaching only enables one way of learning, and that is with the teacher as narrator that transmits knowledge, as someone who is superior to the student and the students as receivers of that information. In this scenario, the student listens and stores the information. It is a passive form of learning, that is not contemporary because students are not actively engaging with their material and are not actively making connections with issues of their times. Without treating learning as something that is alive, students are not absorbed by what they learn and thus cannot make connections with history, the present conditions, and can make inferences as to how that relates to them in their context, and how that may lead to new conclusions, the information is disconnected from the world and current events. The applicability of the knowledge is non-existent when the student cannot make connections. The learning experience eventually becomes only a task, with no active participation on the student's part.

The standards for students in this traditional setting is based off of who can store and repeat the most information. This promotes an unhealthy relationship between teacher and student where there is a clear hierarchy, where the teacher is the source of knowledge and knows everything and the students does not and cannot have a say. Psychologically, this is detrimental because the student will inevitably feel inferior to the person providing them the knowledge.

To reinforce this idea, the classroom is organized with rows of desks facing the teacher, where students are not encouraged to interact with each other. The intent in this format is not to personalize the education, but rather streamline a process for an instructor. Only one type of learning method is practiced, ignoring how a class full of complex and different students might best learn, with the intentions of reaching everyone, but only actually reaching a small percentage. This teaching method and the physical makeup designed for this teaching method promotes teaching everything through lectures. This can be disadvantageous to the majority of the student's development if they are not auditory learners. Under this teaching methodology, many students might seem undisciplined, and inattentive. Teachers that do try to implement other teaching methods struggle with the present classroom configurations. Teaching methods need to be adapted to different learning styles in order to best learn.

### Types of Learners

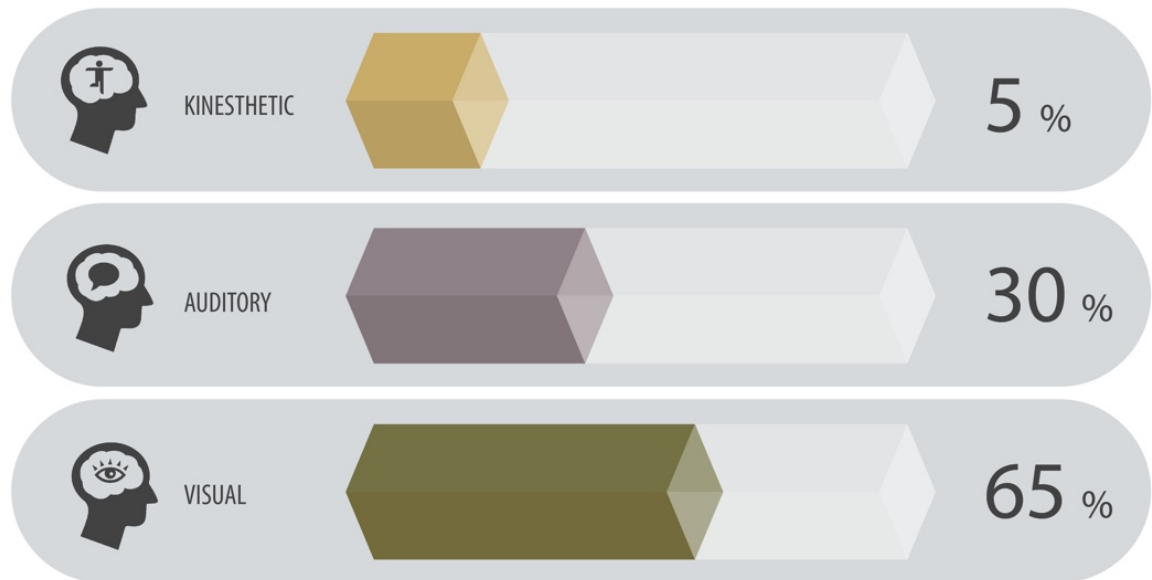


Figure 9: Types of Learners (by Author)

There are three main types of learners, visual, auditory (lecture), and kinesthetic (physical). Most people fall within one of these groups but there are also verbal (reading, writing), logical, social, solitary (intrapersonal), and naturalistic learners. This theory has been put forth by Neil Fleming, a New Zealander in 1987. Visual learners being the most common. These people have a tendency to understand material that they interact with through their eyes, via images, colors, graphs, pictures, maps and more of the like, are good spatial thinkers, and are very detail oriented. Auditory learners appreciate sounds and can pick up pretty easily on rhythms and the spoken word. They remember information better when they hear it rather than if they see it. There are not as many auditory learners as there are visual, but they are still a large part of the population. The third main type is a kinesthetic learner, and that is someone who learns through physical activity and action. Many current educational settings do not accommodate kinesthetic learners, and in order to do so there would need to be a change

in the way material is taught along with where it is taught. Verbal learners, which are who most of the infrastructure is designed for, are drastically different from visual learners because they appreciate long texts since they love language whether written or oral and are good in lecture and note-taking based assignments. From research, it is as clear how many people fall in this category.

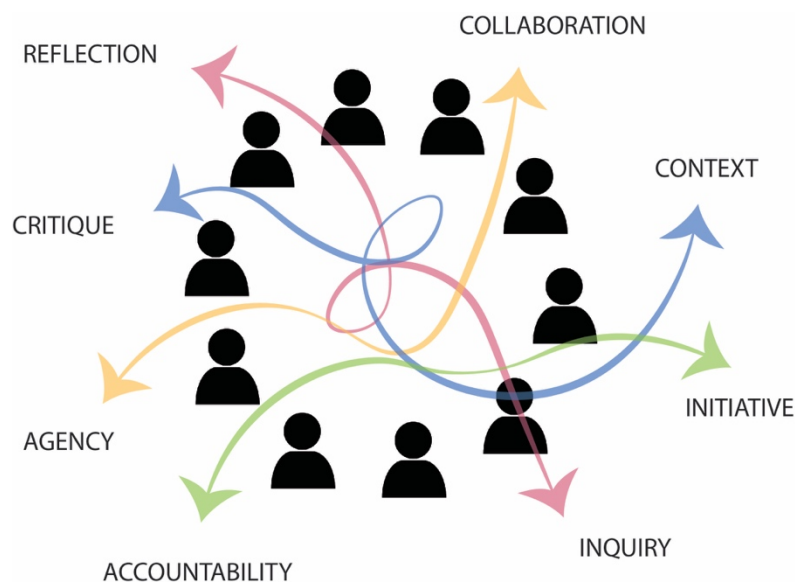
Many people can cross between learning types, but most people have a dominant learning style, and if implemented can maximize the amount of material learners comprehend and retain. Ideally instructors should be aware of the proportions of the preferred learning styles of their students in order to get more through to them. Flexible spaces or spaces adapted for these different types of learning should be available for teachers to access based on changing needs of their classes.

### New Teaching Pedagogies

*“Everyone talks about peace but does not educate for peace. People are educated to compete, and competition is the starting point of most wars. When we start educating for cooperation and solidarity, that day we’ll be educating for Peace.” - Maria Montessori*

Much research has been done by psychologists recently about the best ways of learning, and these break out from the traditional methodologies. Many countries are looking at improving learning conditions for students. Many of the new methodologies of teaching bring children, youth, teachers, and communities to the core and allow them to be the main actors of change.





*Figure 10: New, Student-Centered Method of Teaching (by Author)*

Escuela Nueva is a pedagogical model designed in Colombia in the 70s by Vicky Colbert, Beryl Levinger, and Oscar Mogollon, with a goal to provide complete basic education to rural, isolated, and multi-grade schools. Since its expansion it has been adapted to serve other educational levels, contexts, populations and countries. It now serves 17 countries including Peru. In 2002, the Human Development Report by the United Nations selected Escuela Nueva as one of the top three greatest achievements in Colombia.

The founders strongly believe that education improves the quality of life of people, and that it can impulse change by empowering and enabling students as individuals. In their model, education is seen as the cornerstone of social and human development, encouraging everyone to make it their priority.

It is a model that breaks away from the traditional teaching methodology by promoting an education that is centered on the learner and by facilitating active, participatory, personalized and cooperative learning. One of the main goals of the

model is to construct knowledge socially, by removing the instructor as head narrator and turning them into a guide and facilitator of the learning process that encourages dialogue and interaction.<sup>23</sup>

Theories of student-centered education that encourages learners to actively participate in the learning process have existed for centuries, but traditional methods continue to prevail for fear of the unknown. Escuela Nueva is innovative because it puts these principles into practice in a concrete, easily manageable way. It is a contemporary approach to education since it promotes the development of skills like *learning to learn, create, take initiative, think critically, lead processes, and specially work in teams.*<sup>24</sup>

Project Zero is a project created by Nelson Goodman at the Harvard School of Education in 1967 that focuses on learning in and through the arts, while putting the student at the center of education. It was named after the state of research on cognition and the arts and is now a set of practices and ideas that understand learning through its man complexities. They work towards a more enlightened educational process that prepares student for the world they will live, work and develop in by gathering many disciplines to fully understand human expression and development. Their research focuses on figuring out what learning is relevant to the contexts they are living in. They join theory with practice by collaborating with practitioners who share their inquiries. They have developed theories of multiple intelligences, artful thinking and many more.

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<sup>23</sup> *Que Es El Modelo Escuela Nueva Actica?*, Video, n.d., <http://escuelanueva.org/portall/es/>.

<sup>24</sup> *Escuela Nueva*.

One of their main projects is *Agency by Design*. Their studies have indicated that there are significant benefits from maker-centered learning spaces, for students interested in all fields, creating what they call “maker empowerment”. The maker movement as it has come to be known, has a lot of economic benefits, but mainly, socio-intellectual potential, leading to innovation, invention, and creativity.

The learning outcomes of current maker centered education applied in schools has shown an increase in development of self and community, less to do with development skills, much larger outcomes of self-development and learn technical skills along the way, not the main focus as in more traditional ways of teaching.

These pedagogies are the latest international methodologies for learning. This thesis will take these systems as drivers for the design of the educational facility model in Peru.

Now that it has been established that education is the most powerful weapon in fighting poverty, and that there is poor educational infrastructure in the Amazonian region, the next step is to explore an unconventional and innovative solution to these problems, through studies of educational typologies.

## Chapter 4: School Typology

When designing a school there are many spatial and programmatic considerations to be made. All decisions need to take into account spatial effects on learning, as some spatial implications are more conducive to learning than others. As the previous chapter lays out, the new paradigm of learning requires spaces that can accommodate learners of varied ages, to learn in different spaces and in different ways and school design needs to incorporate this fact when developing learning spaces. In order to design spaces that can successfully house innovative teaching pedagogies we must look at precedents around the world and in the local context that are attempting to tackle these same issues in order to see what works well and what does not.

Randall Fielding and Prakash Nair are global leaders in educational planning and architectural design and have researched and written about such conditions and break down some of the main categories to look at, which include: classrooms, welcoming entries, transparency, interior-exterior vistas and connections, and designing for Multiple Intelligences, among many others but in terms of importance and applicability to this project, these will be the ones focused on. Their design principles for best practice are key elements that make-up a balanced, productive and healthy education that focuses on creating the most efficient, new educational environments for all students in an environment that is conducive to real learning.

## Classrooms

The first space to discuss, in terms of importance, when designing learning spaces for an educational facility is “classrooms” and what they should look like for future generations based on contemporary teaching methods. With the contemporary teaching pedagogies discussed in the previous chapter in mind there are researchers that are questioning the need for this traditional space and its importance in the makeup of a school and are even wondering if this traditional space is obsolete.<sup>25</sup> The classroom is the most symbolic part of an educational philosophy and its original composition assumes that a specific number of students will all learn the same thing at the same time, in the same way, from the same person. The physical composition of this space assumes learning happens in a unidirectional way with direct supervision from an instructor, with active tutelage, as discussed in the previous chapter. With this model for a classroom, there is a logic for arranging classrooms in a linear way, where all classrooms are about the same size and are placed next to each other along a corridor, and in many cases it’s for ease of supervision. In order to differentiate between classrooms that are used for sciences and arts there are labels on the rooms and different equipment within them, and the double loaded corridor is simply used to move students from one of these spaces to another. The term “cells and bells” is used to designate this setup since students move from one of the cells to another along the corridor at the ring of the bell.<sup>26</sup> A majority of schools follow this model. A slightly more progressive evolution of this model is one where the corridor itself is adjusted in width and acts as

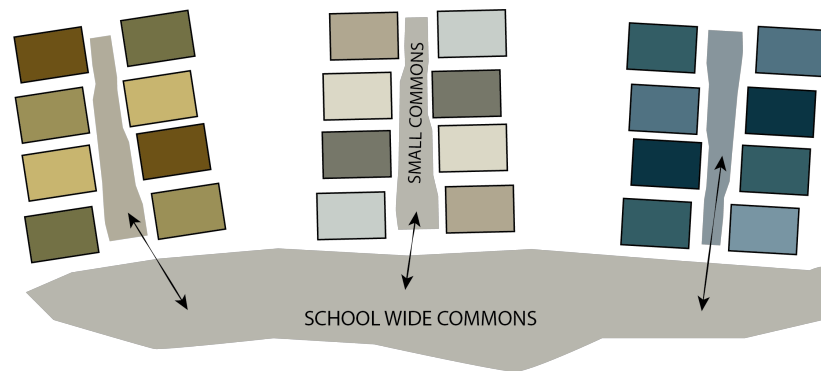
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<sup>25</sup> Dr. Daniel Gray, Interview, interview by Ana Maria Nicolich, Phone, November 9, 2018.

<sup>26</sup> Randall Fielding and Prakash Nair, *The Language of School Design: Design Patterns for 21st Century Schools* (Minneapolis: DesignShare, 2007).

a space of its own for social learning. Locating facing classrooms at different widths from each other allows for the creation of micro-spaces that can increase interaction between students and teachers, and thus increase learning.

This adjusted model can be aggregated along a large wider corridor, or common space, to produce a “finger plan”, where these smaller groupings of classrooms, each with an adjusted corridor and an intimate commons area, feed into the main corridor that begins to act as a flexible learning street.<sup>27</sup> The finger plan, originally thought of by Florence Nightingale for improved conditions of health and hygiene in hospitals can be easily used as a base for school design thanks to its attention to daylighting, cross-ventilation, and improved quality of spaces that have light and air between neighboring wings. In this setup the classroom is a destination and not part of the main circulation. For maximum benefits, each cluster of classrooms can have a different architectural element in order to differentiate it and create individual identity, allowing students to



*Figure 11: Typical configuration of classrooms, with modifications (by Author)*

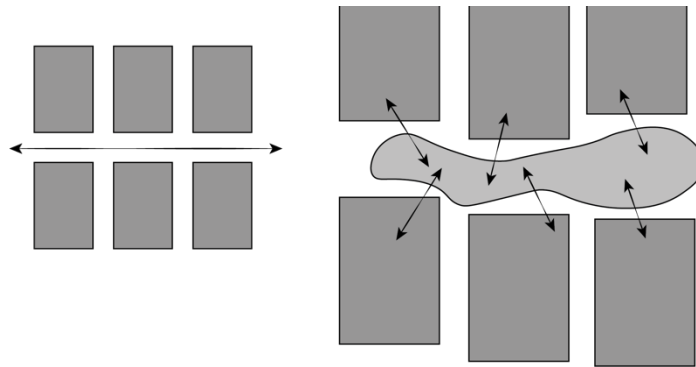
take more ownership of the spaces. Even though this is a simple modification from the traditional model this allows for students to identify a “home base” and can experience a physical change as they transition thematically in their lectures. These are

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<sup>27</sup> Fielding and Nair.

implementations that can be made with a traditional rectangular classroom or a modified version of it, such as a “learning studio”.

*Figure 12: Finger Plan (by Author)*



A learning studio is an alternative to the regular classroom that provides more flexible learning spaces and multiple learning activity centers, oftentimes laid out in an L-shaped space. This design for a “classroom” is ideal for project-based learning because it allows for breakout areas and flexible learning zones.

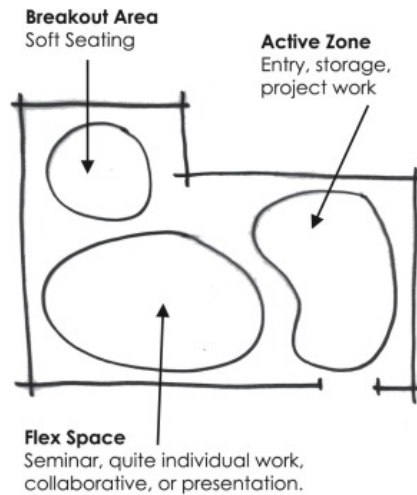


Figure 14: Learning Studio (Fielding, Nair)

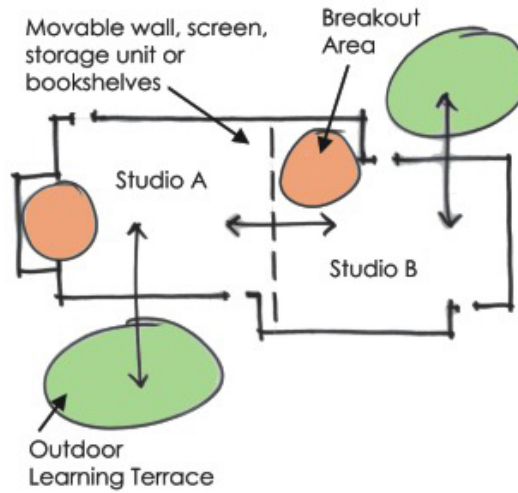


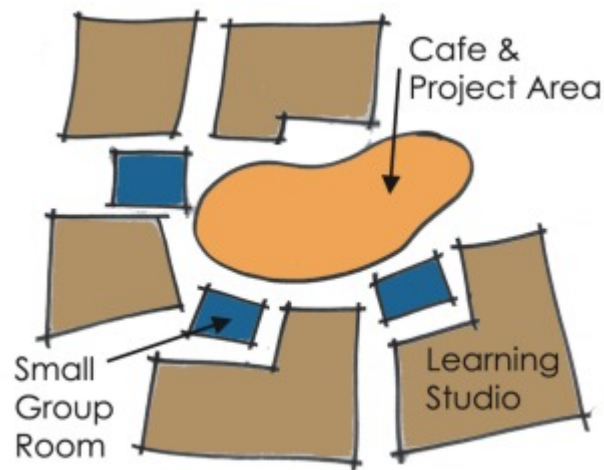
Figure 13: Learning Suite (Fielding, Nair)

Two learning studios combined form a “learning suite”, and in this set up, each studio can have its own entry, breakout area, outdoor connection, and can operate as a single studio or can be combined with the adjacent space to be a shared learning space. The separators between the two flanking classrooms can be movable walls, screens, storage units, bookshelves, or for more fluid connections can be defined by mobile furniture, to allow for expansions of classrooms and for teachers to collaborate. Moveable furniture creates a friendlier way of creating a suite where moveable walls



are a more rigid division between the learning spaces. The furniture separators are good when teachers collaborate often. When repeated around the school this method can have a big impact on the overall school design.

As an alternative to the Finger Plan, a Small Learning Community (SLC) clusters multiple learning studios or suites around small group rooms and has a common working area and can work in a number of different arrangements. These combinations allow there to be more of a sense of community and belonging within the groupings. Each one of these communities can be as small as a couple learning studios around a small group room or as complete with its own bathrooms, its own teacher workroom, its own science labs, and a flexible central multi-purpose social space. The



*Figure 15: Small Learning Community (Fielding, Nair)*

diagram below shows a simplified version of an SLC but that is still effective. Each small learning community and even each studio within it can have a connection to the outdoors.

Depending on the scale of the school, the entire educational facility could be one small learning community, or the communities could be repeated around the school. However, no matter the setup, the small learning communities themselves need to remain fairly small with intimate small group areas for everyone to allow everyone that partakes within that community to know each other. In order to unify these small learning communities there needs to be a connector that can be used as an additional learning space, which can be an architectural opportunity to give the school itself an identity.

The Wilkes Elementary School in Bainbridge Island, WA by Mahlum Architects exemplifies the Small Learning Community Model. Even though the school's learning settings are set up in a more linear manner, there is a shared learning space that extends into their corridor and connects these rooms, where the multi-purpose social space is a combination of a shared learning space and an outdoor space. The shared learning space can be either for independent study, project work, collaborative work or a multitude of other working settings. In this school a range of learning styles are supported. This school is designed believing that learning and play are intimately intertwined. With the thought that play is an essential part of the development of academic skills, the design interweaves social and educational spaces throughout. Most schools separate play and learning spaces, with clear distinctions. The arrangement of their program promotes collaboration and creates opportunities for learning at varied scales, ranging from multi-classroom gatherings, to intimate individual experiences.



Figure 16: Wilkes Elementary School Partial First Floor Plan, Shared Learning Spaces

### Welcoming entry

A successful entrance to a school should provide a friendly sense invitation and avoid being institutional. The two main aspects when looking at entrances is balancing openness and security. Since the community involvement in schools is a crucial part in community development, the community needs to feel welcome and ownership of the facility. The main student areas need to be kept safe and separated from the publicly accessible spaces. The entry should also include a signature element, an element that distinguishes the school and connects to the community identity. A covered entry can be valuable. Valuable for parents lingering in front of the school and it makes for a good transition between street and school while creating a more ceremonial entry. A place for the community and the parents should be included near the entrance. It can enhance the security of the school and it makes it more welcoming. A parent/community room could be a multi-purpose space for meetings, coats, , could have the

capacity to host informal meetings, and could even have a mini-kitchenette or the possibility to connect allow parent to connect through coffee or food.

Programmatically, the entrance also includes the main office, which hosts the majority of the administrative spaces, main contact between community and school, guidance offices, and help desk. Since this is an intermediate connector between the public and the more private student spaces it serves to put “eyes on the street”. On the public side it serves as security and on the school side as supervision, for teacher to monitor student’s areas. In order for the school to feel like it belongs to the students there needs to be a display of student work near the entry, a way to showcase the students and their learning. These thoughts are also shared by the BaLA initiative discussed later in this chapter. Lastly, a welcoming entry should also be a visual connection to some kind of student activity since that is the essence of an educational facility, whether that be a main courtyard, greenhouse, or even students at work.

### Transparency

The issue of transparency is one of the more important issues in school design because it carries over to many of the other design considerations and can have important influences in the final design of the school. Transparency in a school suggests that learning is visible and celebrated.<sup>28</sup> Many ideas of which are shared with “Visible Thinking” research through Project Zero.

High levels of visibility through formal and informal spaces can be beneficial because it can introduce natural light into the building, a topic which is discussed in further detail in a following Chapter 6: Sustainable Building Practices, and it can allow

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<sup>28</sup> Fielding and Nair.

for “eyes on the street”. Sound is not an issue with all of this transparency because there can still be acoustic barriers while providing a sense of openness. Spaces that have great opportunity for transparency are the Main Office, the interstitial space between the main entrance and the first public space, between classrooms and informal learning areas outside of classrooms, which can be good for monitoring, and most importantly, transparency from classrooms to corridors for improved light and openness. This makes classrooms feel more open and it creates more interesting sight lines throughout the sequence of the building. This connection can create a meandering path for the visitor rather than something that is rigid. More transparent buildings allow for the creation of nooks and crannies that can be good for sporadic learning spots, which is beneficial since it is always good to provide spaces for informal learning.

### *Interior and Exterior Vistas and Connections*

Being that a lot of the learning happens indoors, there is a need to connect to the outdoors visually. There is great benefit of expanding the sight lines as far as possible from an interior space.<sup>29</sup> Creating vistas that are greater than 50’/ 15m away from interior spaces can be beneficial to students since it creates a moment of relief for those that have been focusing on textbooks, notebooks, and computers at close range for hours.<sup>30</sup> This allows to increase the range of focal points and has qualitative benefits of framing views from interior spaces. Along with these visual connections, it has been proven that creating physical connections are important. There are many ways to naturally connect indoor learning to the outdoors. Some options are more formal

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<sup>29</sup> Fielding and Nair.

<sup>30</sup> Fielding and Nair.

learning terraces or more organic nature trails. Nature trails can be a good way of directly teaching about biology, ecology, botany and animal behavior. This can be especially important for this thesis since part of the province of Satipo's goals are to remind people of the importance of the amazon and the richness of the ecology of the area.<sup>31</sup> This could extend to all of the deployable models in the amazon as for reasons of preservation. The vision for the development of the Province of Satipo is deeply tied to preserving their environmental patrimony, with a particular line item that addresses the importance of the province's conservation of the environment and sustainable use of natural resources. The province identifies one of the downfalls of the area being the lack of enough sensibility and awareness to the value of natural resources. Education could take this on as an opportunity.

At one level, outdoor spaces can simply be an outdoor version of the same learning that would take place indoors, but more can be taken away from outdoor spaces. If properly designed, they can provide opportunity of learning that cannot take place indoors. Exterior spaces can easily accommodate large and messy projects and activities, while also providing the opportunity to learn about gardening, farming etc. The site development of the school can be done in a way that promotes local wildlife. A simple way of creating these outdoor spaces is expanding the roof to create covered areas, but that are still open to the elements, this creates an easy transition between these spaces. Open interior courtyards can serve as circulation, social and independent study spaces. Many of the precedents analyzed below contain this important element.

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<sup>31</sup> Provincial Municipality of Satipo, "Plan de Desarrollo Concertado Provincial Satipo 2008-2021," 2008.

Jerusalen de Miñaro Primary School, a school designed by Semillas, is located in the district of Pangoa, in the province of Satipo. The physical configuration of this school provides a successful local example of a school that connects to its exteriors and incorporates it into a practical, programmatic use. The school incorporates “democratic space” that serves children, youth, and adults. The project proposed a revaluing of local materials and was designed to accommodate new pedagogical methodologies.<sup>32</sup> There are spacious covered patios connecting the classrooms, that belong to the exterior, and have become an important space for the students to inhabit, and have taken ownership. They have become part of routes of play for the students and lead them to Parquebambu which is a park that was thought of during workshops with children during community

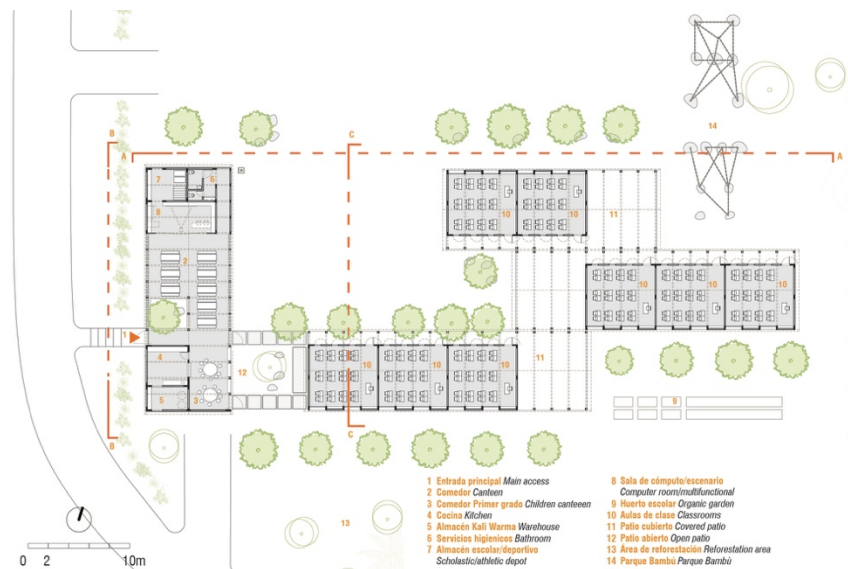


Figure 17: Jerusalem de Miñaro Primary School Floor Plan (Semillas)

meetings. More details about this project are included in Chapter 6: Sustainable Building Practices.

<sup>32</sup> ArchDaily, “Nueva Escuela En La Comunidad Nativa de Jerusalén de Miñaro / Semillas,” ArchDaily, June 1, 2018, [https://www.archdaily.com/893791/new-jerusalen-de-minaro-primary-school-semillas/?ad\\_source=myarchdaily&ad\\_medium=bookmark-show&ad\\_content=current-user](https://www.archdaily.com/893791/new-jerusalen-de-minaro-primary-school-semillas/?ad_source=myarchdaily&ad_medium=bookmark-show&ad_content=current-user).



*Figure 18: Interior/Exterior Spaces at Jerusalem de Miñaro Primary School*

School in Chuquibambilla, is a school designed by AMA + Bosch Arquitectos in the eastern district of Pangoa for the native community in the region. The school consists of three educational modules and one residential, with classrooms, dorms, and administrative program organized around a central courtyard, with some additional covered and uncovered patio spaces sprinkled around. The program includes spaces for outdoor activities, art and clay workshops, and agronomy all connected through covered paths that become part of the program. The building intends to blur the



*Figure 19: School in Chuqibambilla Floor Plan*



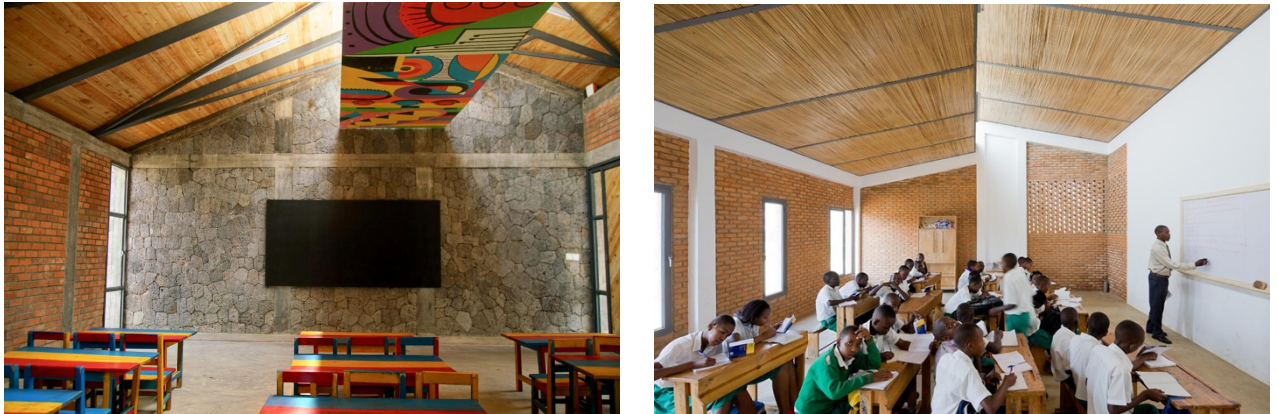
connection of interior and exterior spaces in order to be better connected to the environment.



Figure 20: Exterior Spaces at School in Chuquibambilla (ArchDaily)



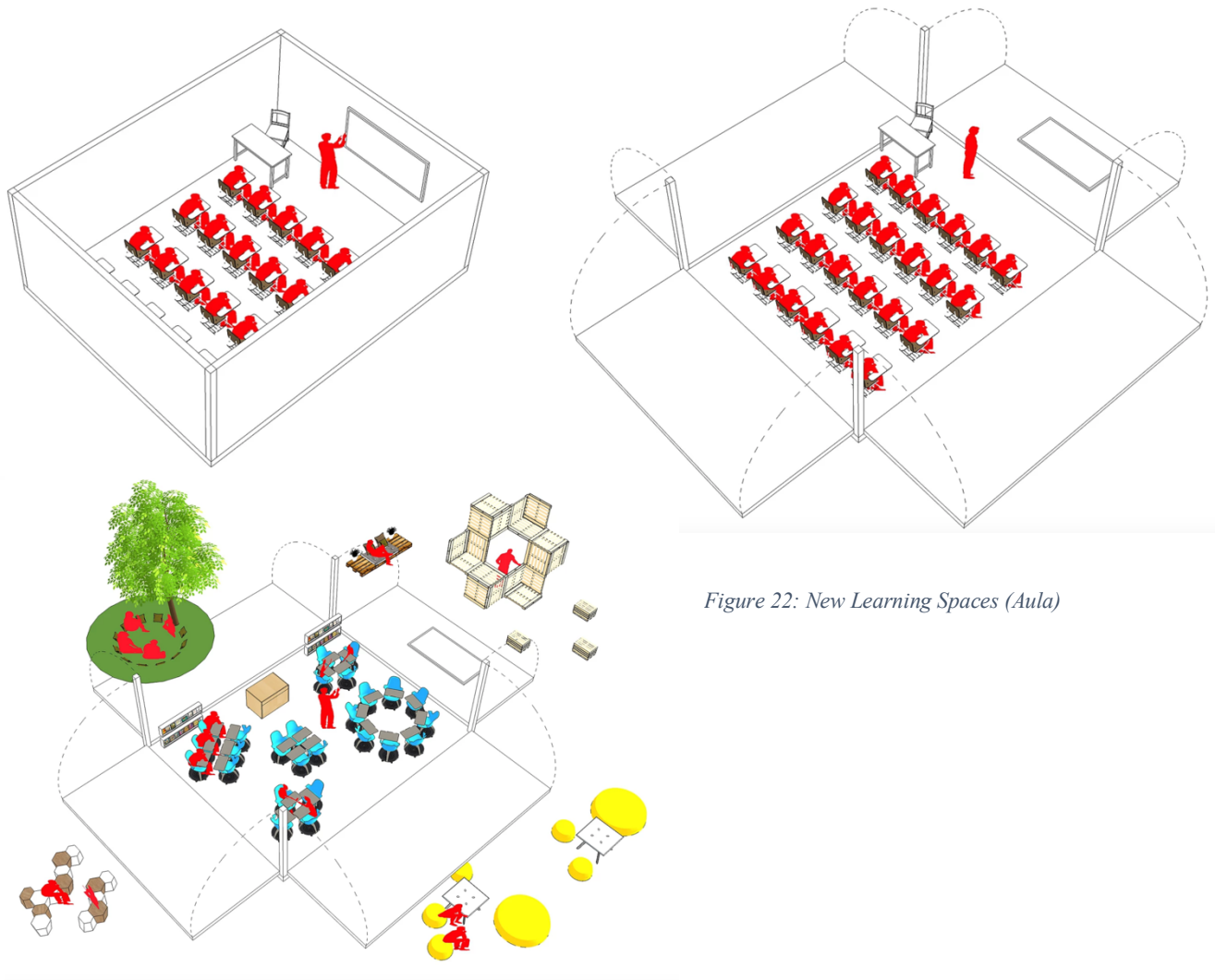
The precedents designed by MASS were chosen for analysis because of the quality of care taken into consideration within their design. The team at the non-profit architecture firm asks itself critical questions for every new project they design, including some that this thesis explores as well, such as: Can a school's design serve as an example for improving education? Can design amplify conservation efforts? Can design improve access to learning? Can a school serve as a community catalyst? How can a school's mission inform its physical space? Can a training space help end extreme poverty?



*Figure 21: Ruhehe Primary School (MASS)*

### Aula

Aula is a team of architects that searches to positively impact children's learning in Peru through the improvement of their school infrastructure. The co-founders are architects that participate in the Plan Selva designs of educational infrastructure in the Amazon, and architects that work for the ministry of education, among others. Their premise is that teaching in the last few years has changed but learning spaces have not and continue to be the same ones used for decades, such as the cloister type model inherited from the Prussian educational system. Aula creates new spaces for learning by rethinking traditional learning spaces and settings in schools. Some of their projects benefit from recycling materials and using low cost resources.



*Figure 22: New Learning Spaces (Aula)*

### BaLA

The Department of Education in India has begun implementing an innovative initiative in an effort to provide quality education in public schools, the Building as a Learning Aid (BaLA) initiative thought of by architect Kabir Vajpeyi. This philosophy looks at educational spaces themselves as resources and at maximizing every small detail in the physical surrounding of students as a source for children's learning, where every material can become a learning situation. Vajpeyi, who sees himself less as an

architect and more of a social justice leader, believes that designers need to create value in educational buildings in order for children to properly be educated.

## Chapter 5: Sustainable Building Practices

*“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”* – 1987 UN Brundtland Commission Report

Incorporating sustainable strategies in the design process of the educational facility is essential to help solve some of the problems established in Chapter 3, to meet some of the goals set forth by the Development Plan of Satipo, and to meet some of the larger UN’s 2030 Sustainable Development Goals. Based on studies conducted around the world, sustainable educational facilities create superior learning environments. Research shows that sustainable spaces lead to higher productivity and higher test scores from students, increased student attendance, enhanced teacher performance and satisfaction, increased building life, and lower environmental impact, among other benefits.<sup>33</sup> Some elements of sustainable schools that will be discussed in this chapter are Daylighting and Natural Ventilation, Bio-Climatic Design, Site Responsive Materials and Modular Design. In order to properly understand the benefits that are most appropriate to the selected sites in Amazonian Region we must first understand the local climate, its potentials and limitations.

### Local Climate

The Office of Educational Infrastructure of the Ministry of Education of Peru has determined 9 different climatic zones within the country in order to create specific bioclimatic recommendations for educational architecture seen in the map below.

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<sup>33</sup> Lisa Gelfand, *Sustainable School Architecture: Design for Elementary and Secondary Schools* (John Wiley & Sons, Inc., 2010).

Satipo falls under Zone 7, Ceja de la Montana (Eyebrow of the Mountain) which is a transition zone between the lowland jungle of the Amazon and the highlands of the Andes, which is characterized by constant fog as the clouds transition from the jungle to the mountains.



Figure 23: Climate map of Peru (MINEDU)

The Province of Satipo has a tropical climate that is semi-hot and humid with intense rain from November/December through May/June. A climate report for the Satipo province has identified the diverse climates present within this territory, which

expands for 19,219 km<sup>2</sup> (4749118.3 Acres), making it the largest department of Junín.<sup>34</sup> Some basic characteristics of the climate for Satipo are listed below:<sup>35</sup>

- Annual Precipitation is between 2,001-2,500 millimeters.
- High Relative humidity: between 70% -100%
- Average of 12 hours of sun daily
- Wind: 3.1-3.6 mph, predominantly from North
- Temperature: average of 71% for low, average of 88% for high
- Mostly overcast throughout the year

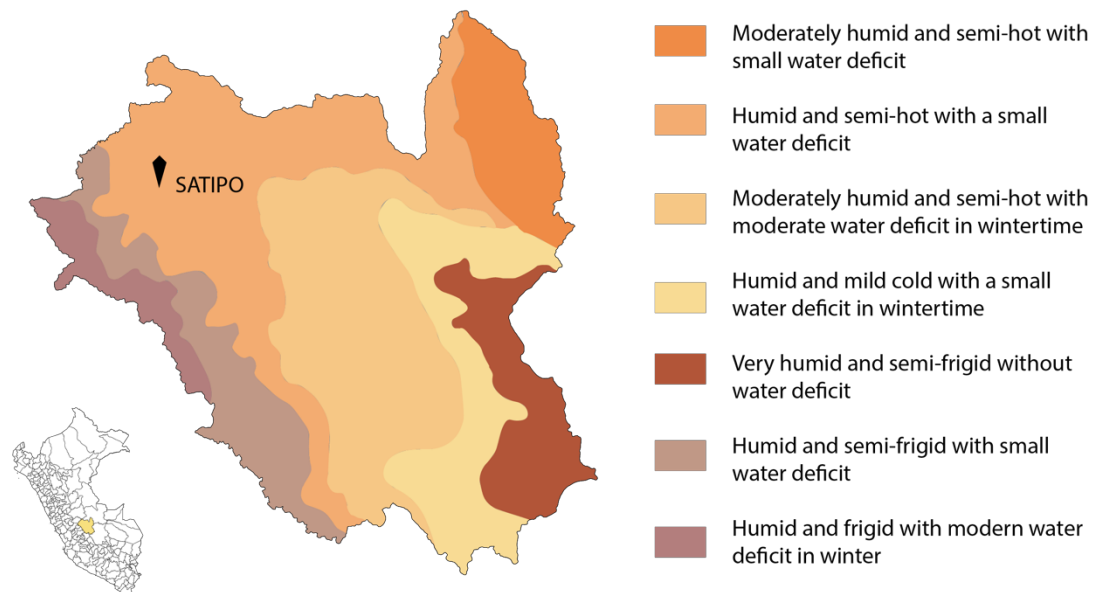


Figure 24: Climate Map of Satipo Province (by Author)

There is an opportunity to benefit from the natural high rainfall and many daylight hours on the site. Based on this climate zone, MINEDU's specific design recommendations layout a good starting point. They suggest the basic plan be open with patios and include tall spaces with large volumes with a minimum interior height

<sup>34</sup> Juan Manuel Ramirez Barco, "Mesozonificación Ecológica y Económica Para El Desarrollo Sostenible de La Provincia de Satipo." (Iquitos, 2010).

<sup>35</sup> Ministerio de Education, "GUÍA DE APLICACIÓN DE ARQUITECTURA BIOCLIMÁTICA EN LOCALES EDUCATIVOS" (Lima, Peru, 2008).

of 3.5m (11.4'). In terms of materials, they suggest a medium thermal mass with insulating roofs that prevent storage of thermal heat and warn against overheating walls and exterior floors. The orientation of the axis of the building should be East-West, where the spaces that are oriented to the north should be protected and where openings in general should be protected to avoid excessive sun. The building should also take maximum advantage of local winds for humidity purposes. Roof slopes are suggested to be >80% in with gutters and downspouts for proper drainage. Exterior walls should be protected against humidity. The building should have an orientation that allows for cross ventilation and should make an effort to utilize stack ventilation in order to force hot air out.

### Daylighting

*"A room is not a room without natural light."* – Louis Khan (1971)

The most important part of a sustainable school is the quality of its learning spaces. Out of all of the design elements for sustainable schools, daylighting has the highest impact on the quality of student learning and when used properly can improve health and productivity and can offer comfortable and pleasurable spaces. There are studies that correlate well-being with the amount of daylight received.<sup>36</sup> Because students spend a majority of their day inside it is important for the spaces they learn in to have adequate amounts of natural light. Studies show that students can improve their performance between 20% - 26% when they are in a daylit classroom as opposed to a non-daylit one.<sup>37</sup> Student's reading results are 13% higher when daylight is maximized,

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<sup>36</sup> Fielding and Nair, *The Language of School Design: Design Patterns for 21st Century Schools*.

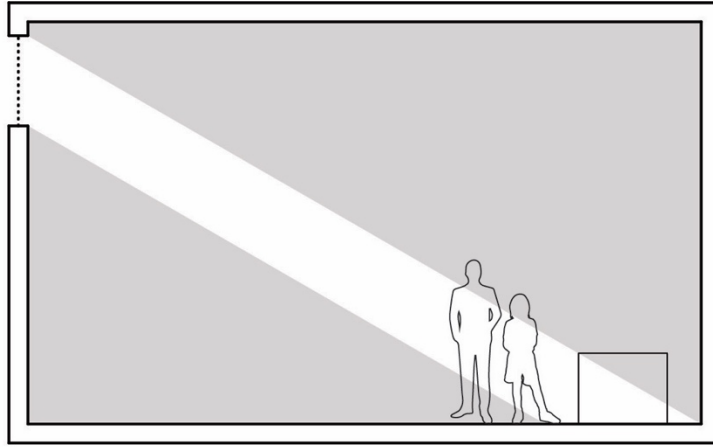
<sup>37</sup> Gelfand, *Sustainable School Architecture: Design for Elementary and Secondary Schools*.



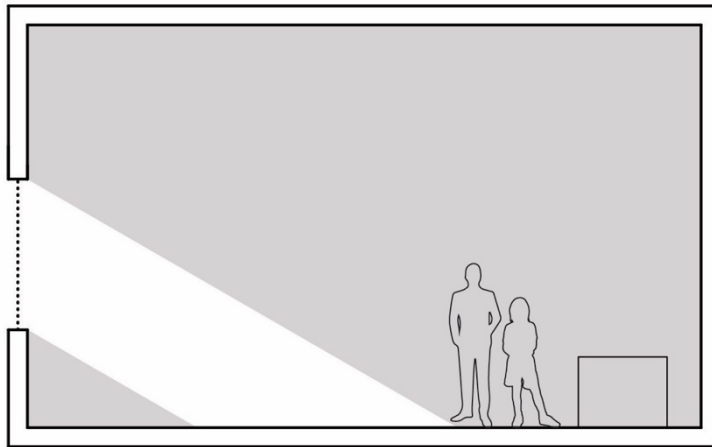
and math scores are improved by 9% in the same conditions. Classrooms that apply the maximum number of windows and skylights have similar results. Other studies also indicate that being exposed to daylight can improve mental functioning, can reduce depression, and can eliminate aggressive behaviors. Aside from the experiential improvement, proper use of daylight and relying on it as the main source of light for a school can relieve the energy load for that school by lowering the burden on heating and electricity that may be scarce in remote areas of the Amazon. In some sites, maximizing this natural resource might be a necessity, in others it can be an added benefit.

There are many ways in which daylighting can be incorporated into the design of a school, some interventions are at the scale of a room, some at the scale of the building, and others at the scale of the site. Within a learning space it might be as simple as incorporating windows, skylights and light shelves. Design decisions such as eliminating full walls in order to maximize the amount of natural light that is brought into an interior space, are bolder moves and can have bigger impacts. Whatever the scale of the move, good daylighting will allow light, but not heat or glare to enter the room. It will not only provide better light quality, but it will also create connections to nature, which as seen in the previous chapter can have positive impacts on learning as

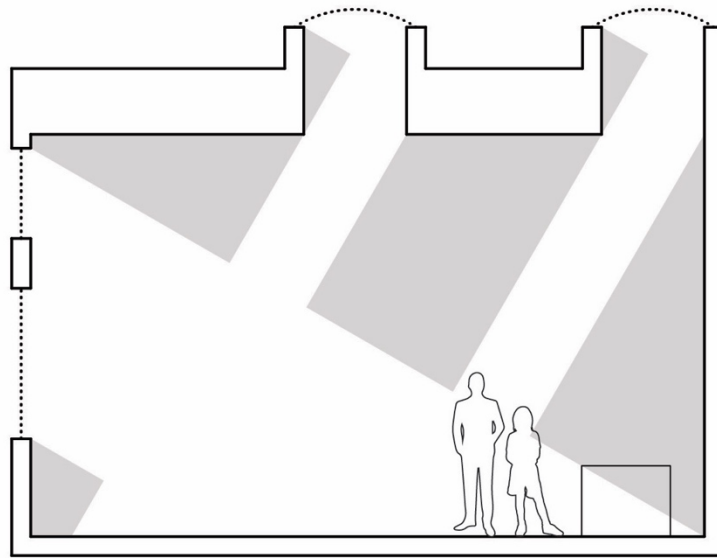
well. It can facilitate daily visual tasks that are integral to learning (writing, reading, observing) and can engage students in these tasks along with the entire learning space.



*Figure 25: Daylighting Windows (by Author, based on Gelfand Partners Architects)*



*Figure 26: Windows Optimized for View (by Author, based on Gelfand Partners Architects)*



*Figure 27: Skylights for Daylighting (by Author, based on Gelfand Partners Architects)*

For daylighting to be successful many aspects of the building design will be influenced. The building location on the site, the shape, size and orientation of openings, space planning in the building, shading, and detailing of windows and skylights all need to be thought of simultaneously.<sup>38</sup>

Site design is greatly affected when daylighting is taken into consideration. Because it is such a large design driver, it needs to be looked at early on and with site conditions in mind. Important factors to include when planning the site are: efficient circulation and educational adjacencies, variety and potential of outdoor spaces, desirability of narrow east-west orientation for buildings housing daylit spaces,

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<sup>38</sup> Gelfand.

potential for locating functions requiring less daylight spaces on east and west faces, and screening east and west windows with planting.<sup>39</sup>

In the Southern Hemisphere, the south sky is an ideal broad source for cool, even and diffuse light. This southern light, when spread evenly around a room can create a calming and appealing effect, which means that locating a building with its long axis oriented from east to west can create the opportunity for large window walls on the faces that are most easily controlled, the north and south faces.

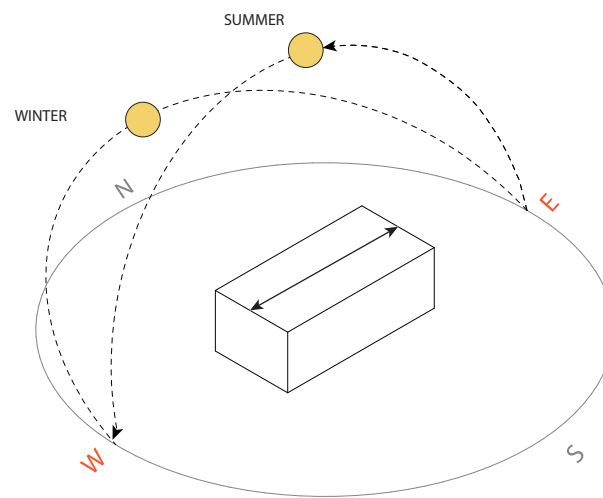


Figure 28: Building Orientation in Southern Hemisphere (by Author)

The solar heat gain from this orientation may not be desirable in the hot climate of the site but can be easily controlled with overhangs or other design decisions since the orientation is desirable for the majority of the day. It is more problematic to control heat gain and glare from the East and West sun without blocking views, therefore it is important to minimize the glazing along those sides or think critically about the program that is located on those sides. Natural light that comes through these directions

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<sup>39</sup> Gelfand.

should be treated differently at the building scale. Trees around windows can help on the East and West but need to be thoughtfully selected and located on the other two faces in order to make the most of the sun throughout the year. Hierarchy in spaces will determine the amount of floor area and of volume required for each program, which can create opportunities for main spaces to “lend” light to supporting spaces and for locations for clerestory windows and surfaces for light to bounce into support spaces. Different floor plan layouts create different opportunities for these spaces to maximize their daylighting.

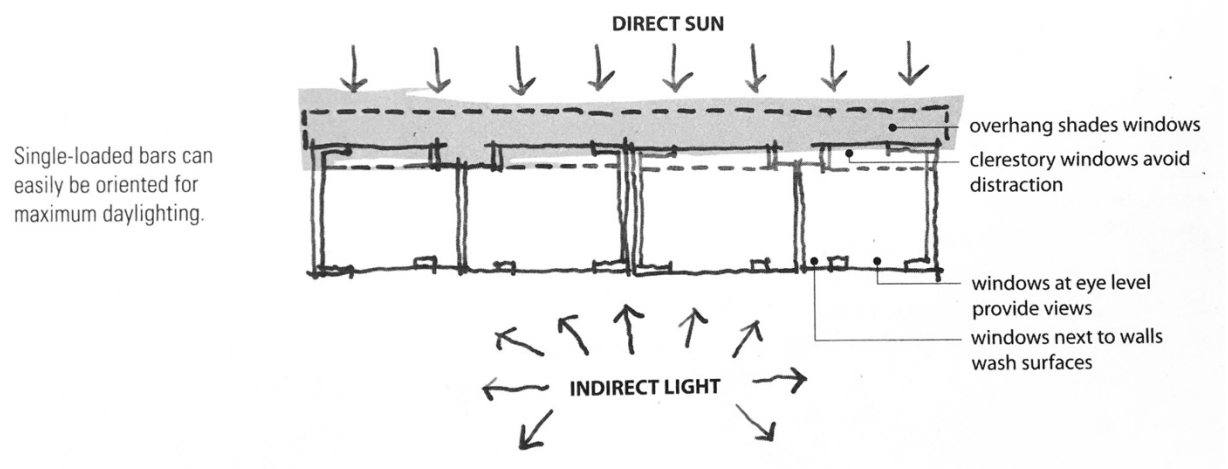


Figure 29: Single-Loaded Bar Daylighting Diagram (Gelfand Partners Architects)

Double-loaded bars require different solutions on each face and a strategy for corridor lighting.

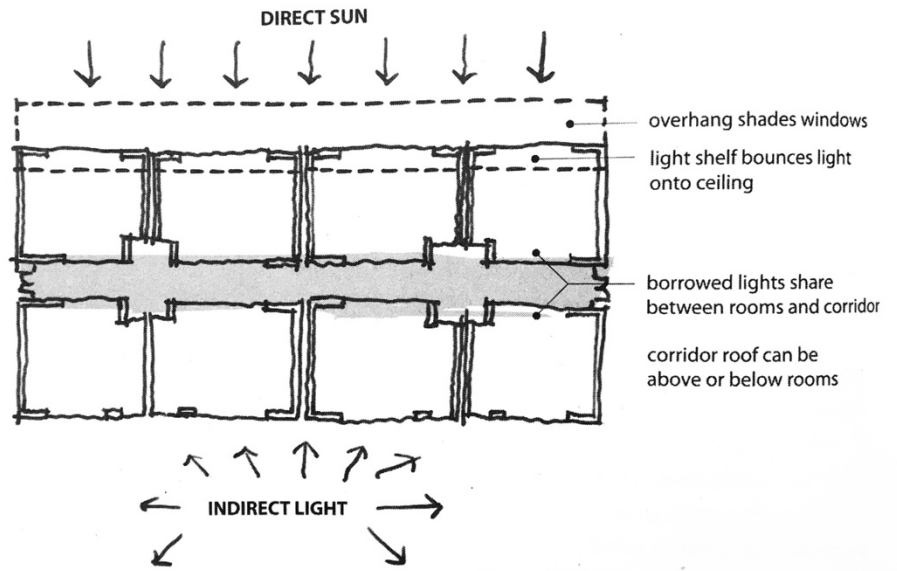


Figure 30: Double-Loaded Bar Daylighting Diagram (Gelfand Partners Architects)

Courtyard schools look inward and need different daylighting solutions for all outer walls.

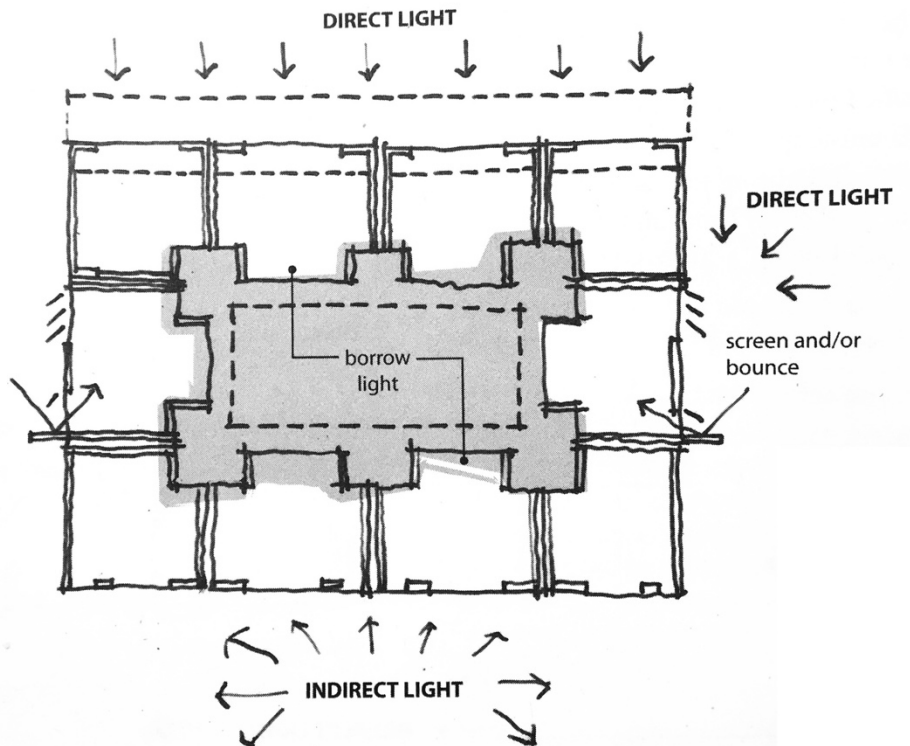
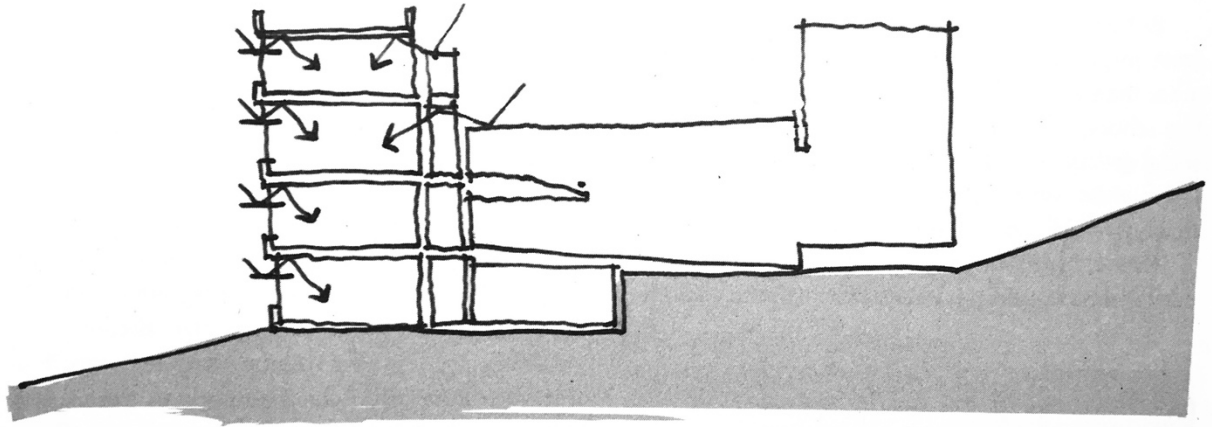


Figure 31: Courtyard Schools Daylighting Diagram (Gelfand Partners Architects)



The multistory building offers some opportunities when functions have different ceiling heights.

*Figure 32: Multistory Daylighting Diagram (Gelfand Partners Architects)*

For a successful daylit room, view windows and daylight windows should be critically located in order to minimize distractions but to maximize light entry. A strategy is to locate a mix of windows at different heights and locations in order to maximize the amount of space that's lit. For skylights to work their best, there should be white surfaces in the wells for bouncing light and the possibility to ventilate to avoid condensation. Coupling skylights with light shelves allows for further penetration of light into a room since the shelves allow for light to bounce into the ceiling. View windows can be located next to walls in order to create a similar effect as clerestory windows having light wash inner walls and vertical fins recreating a similar effect as light shelves. A classic finger plan school in the southern hemisphere would have view windows on the south side facing outdoor spaces between wings, and daylighting windows high on the north side under an overhang and above people passing through corridors.

Daylighting, as a critical design element is intrinsically tied to natural ventilation and can create good opportunities for flow of fresh air in a space.

### Natural Ventilation

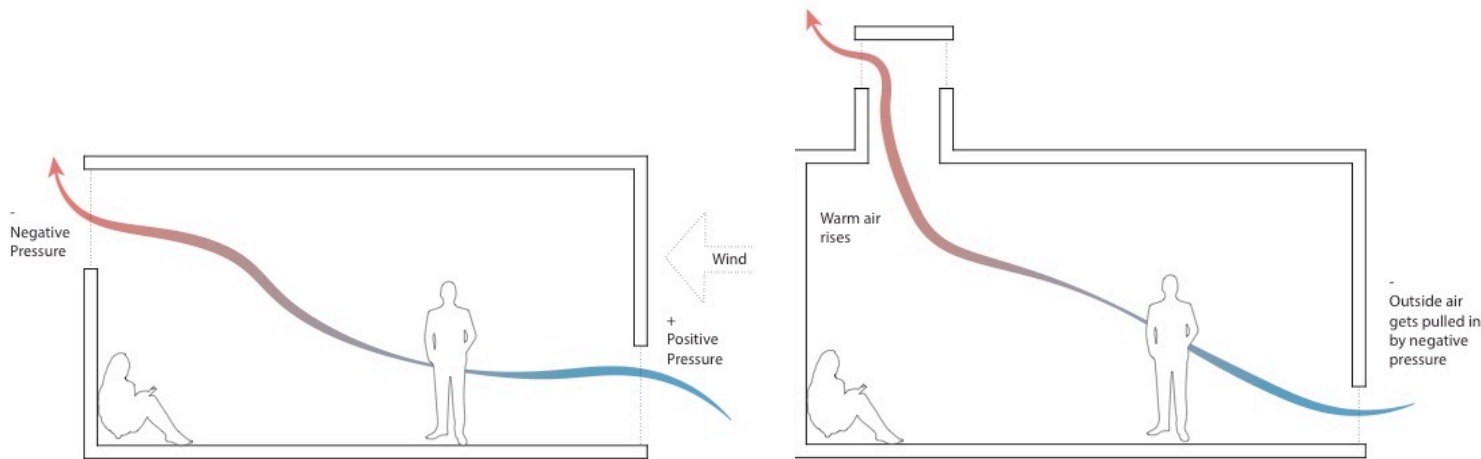


Figure 33: Cross and stack ventilation (by Author)

Natural ventilation, similarly to daylight, is an important part of creating a healthy and sustainable learning environment.<sup>40</sup> Proper ventilation can prevent the formation of mold, which has serious health implications, that can easily occur in humid regions of the Amazonian Rainforest. In order to maintain a healthy indoor environment, the design of the built form will need to take into consideration natural methods of increasing air-flow since the region might not allow for traditional ways of incorporating natural ventilation, such as typical mechanical systems. The design can explore cross and stack ventilation. Stack ventilation works thanks to pressure differences when rising warm air sucks outside air in with it, whereas cross ventilation

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<sup>40</sup> Fielding and Nair, *The Language of School Design: Design Patterns for 21st Century Schools*.



works thanks to pressure differences on flanking sides of the space.<sup>41</sup> A consideration for a naturally ventilated space that must be made is fresh air distribution. Not all students will be able to sit near an open window and thus a ceiling fan would be needed to keep the air moving throughout the space. Since natural ventilation may not be comfortable year-round, provisions need to be made for tempering and filtering. Some elements that can be used may be storm-proof louvers/ backdraft dampers/ heating coil/filters/ grille assembly.<sup>42</sup> Considerations need to be made for a climate that is hot and humid for the majority of the year. Beyond these benefits, there is value to allowing the users of the space the ability and flexibility to adjust openings to personally regulate natural air flow for optimal learning conditions.<sup>43</sup>

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<sup>41</sup> Gelfand, *Sustainable School Architecture: Design for Elementary and Secondary Schools*.

<sup>42</sup> Gelfand.

<sup>43</sup> Fielding and Nair, *The Language of School Design: Design Patterns for 21st Century Schools*.

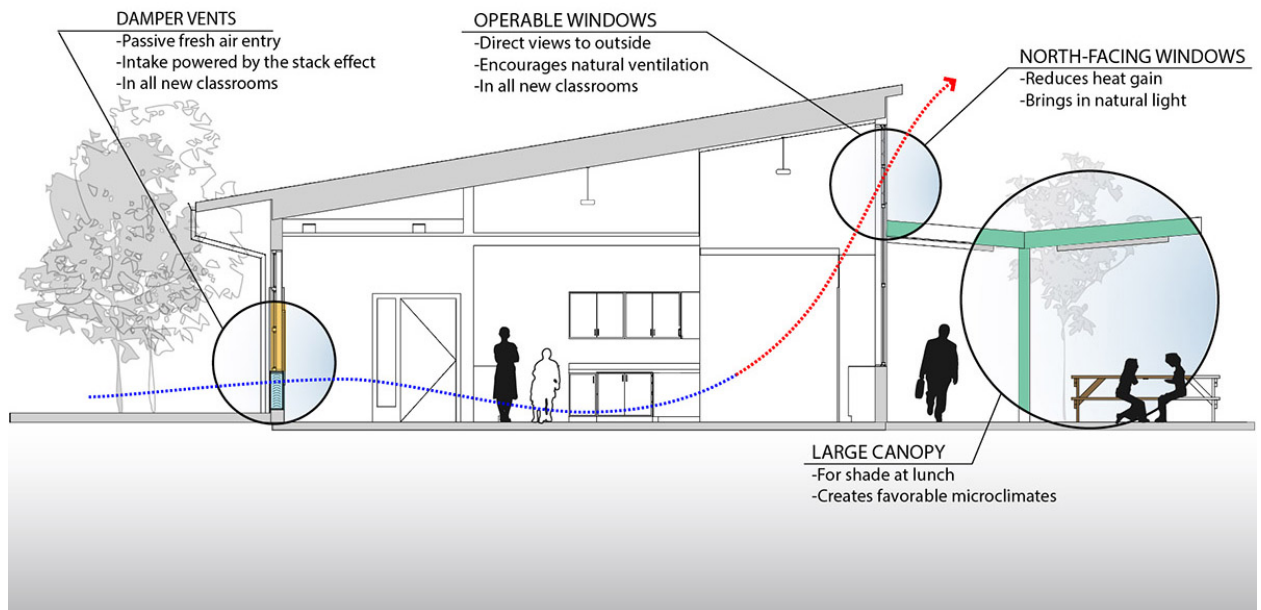


Figure 34: Duveneck Elementary School Section Showing Natural Stack Effect Ventilation (Gelfand Partners Architects)

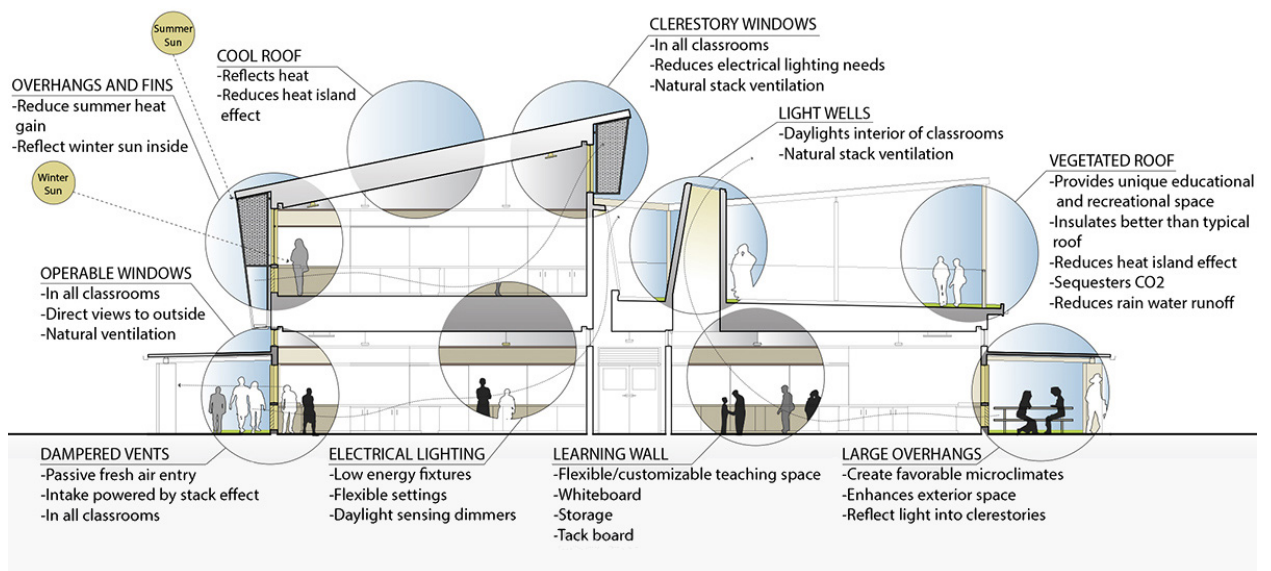


Figure 35: Section through Ohlone Elementary School showing Daylighting and Natural Ventilation (Gelfand Partners Architects)

## Site Responsive Materials – Amazonian Vernacular Architecture

The most sustainable way to build is by using local materials. In order to understand Vernacular architecture of the Peruvian Amazon a couple of typological precedents have been selected. Samuel Bravo is an architect specializing in traditional building practices and contemporary architectural production and for nine years has been working with indigenous communities in the Amazonian rainforest in Peru. Sandra Iturriaga and his design for the Ani Nii Shobo Healing Center and the Nii Juinti Traditional School exhibit vernacular architecture and materials in a contemporary application. Ani Nii Shobo, big house of the forest, in Shipibo language, was built between 2009-2014 and is located in the Ucayali Region of the Amazon. A region with seasonal floods that inundate the areas surrounding the Ucayali River, with levels fluctuating up to 8m (26 ft). The project was constructed with vernacular architecture in order to take advantage of local craftsmanship and immediate materials as is customary in this region. It exemplifies a lot of the suggestions seen for infrastructure for this climate zone as detailed earlier in this chapter. To adapt to the extremely hot and wet climate they only use local materials.

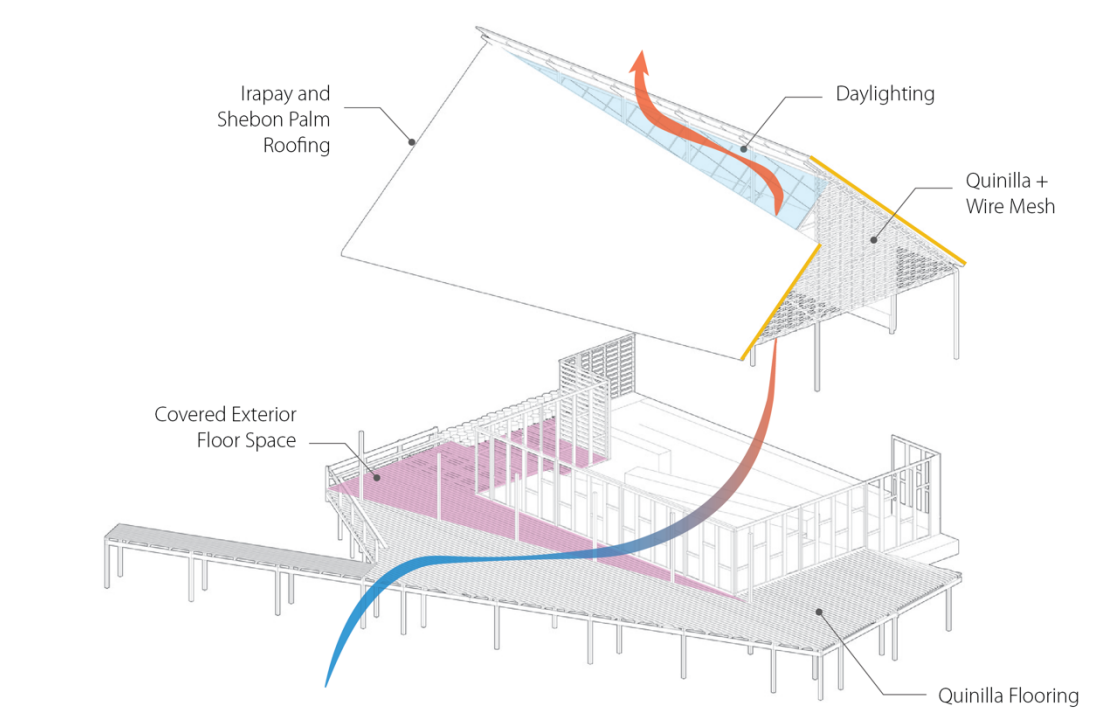


Figure 36: Site Responsive Design in Anii Nii Health Center (by Author)

They apply a structural wood grid for simple modularity made up of Quinilla (*bidentata manilkara*), a local wood. The roofing is composed of two different types of palm leaves: Irapay, which lasts about 3-3.5 years, and Shebon, which lasts between 7-10 years. These palm leaves are woven as seen in the diagram below, to create a waterproofing roof membrane. Their exterior walls are composed of the same Quinilla combined with a wire mesh. The interior paneling is made up of a higher quality wood, Capirona (*calycophyllum spruceanum*). Pavement and decking around the complex is built from Quinilla and Hihuahuaco (*Dipteryx Micrantha*). Some native landscaping includes Pachuco trees that have slender pale trunks.<sup>44</sup>

<sup>44</sup> Samuel Bravo, "ANI-NII-SHOBBO," 2017, <https://samuelbravo.com/>.

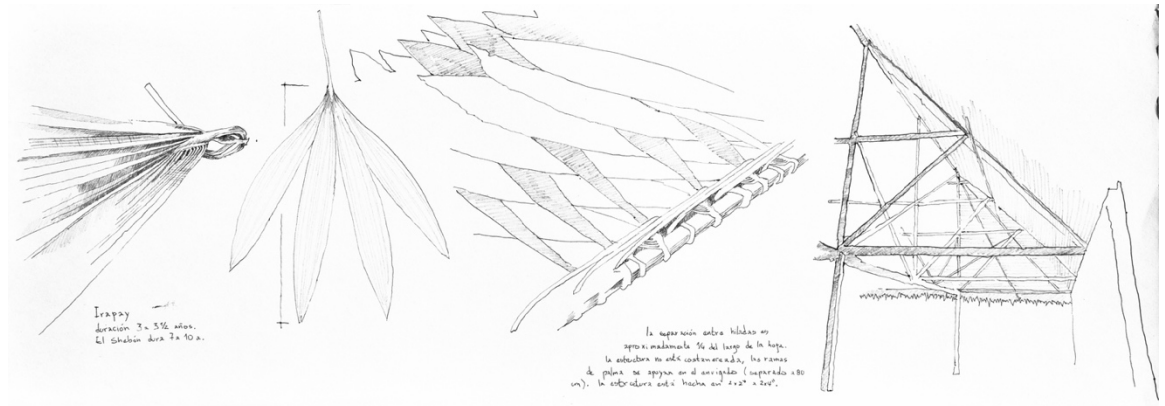


Figure 38: Irapay Palm as Roofing Material (Bravo)



Figure 37: Irapay Palm as Roofing Material (Bravo)

The volumes that house their program have tall roofs with steep slopes that are preferable for runoff of the heavy rainfall that they experience and have permeable siding to circulate the hot air that accumulates at the top of the space in order to create an airy and shaded space in the inhabitable space below. Their dining room has the option of being completely closed or completely open, creating a covered terrace that



has breathable skin. Roofs overhang to protect and shade corridors and common areas that host daily activities.

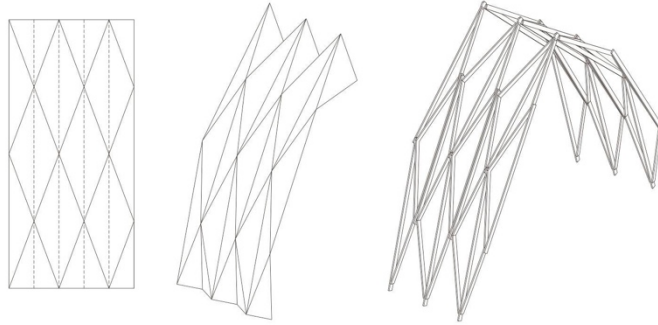


*Figure 40: Dining Room at Ani Nii Shobo showing porosity for Natural Ventilation and Daylighting (Bravo)*



*Figure 39: Quinilla Flooring and Covered Walkways at Ani Nii Shobo (Bravo)*

The Nii Juinti is a school and home catered towards the teachings of traditional medicine of the Shippibo community in the same region that uses the same local materials. The school uses typical Shebón (palm) constructions but applies it in an innovative way, creating a flexible cloak-like envelope for the roof structure.



*Figure 41: Folded Paper-Inspired Outside Shell for Nii Juinti School (Bravo)*



*Figure 42: Nii Juinti School Roof System (Bravo)*

## Chapter 6: Sites and their Community

### Site Selection Criteria

The site options were narrowed down based on the climatic zone map created by the Ministry of Education for their Guide for Bioclimatic Architecture in Educational Facilities. They identify 9 climatic zones which include: Zone 1 Desert Marine, Zone 2: Desert, Zone 3: Low Inter-Andean, Zone 4: Meso-Andean, Zone 5: High Andean, Zone 6: Snowcap, Zone 7: Mountain Brow, Zone 8: Humid Sub-Tropical, Zone 9: Humid Tropical; three of which fall within the Amazonian Region, Zone 7, 8, and 9. In order to explore the deployability of this thesis, one site was selected in Zone 8 and the other in Zone 9, with the potential of deployability in Zone 7.

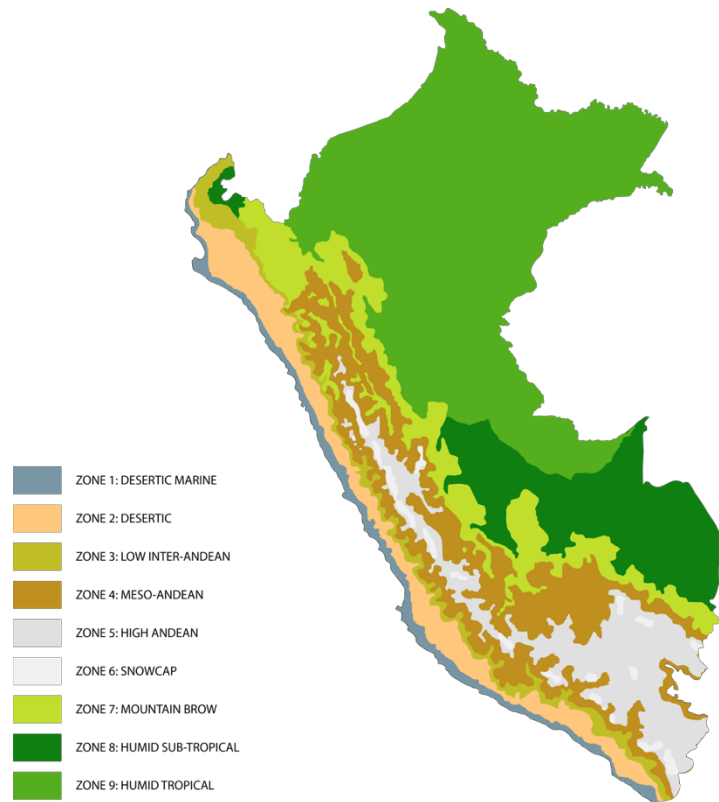


Figure 43: Climatic Zones as defined by the Ministry of Education (by Author)



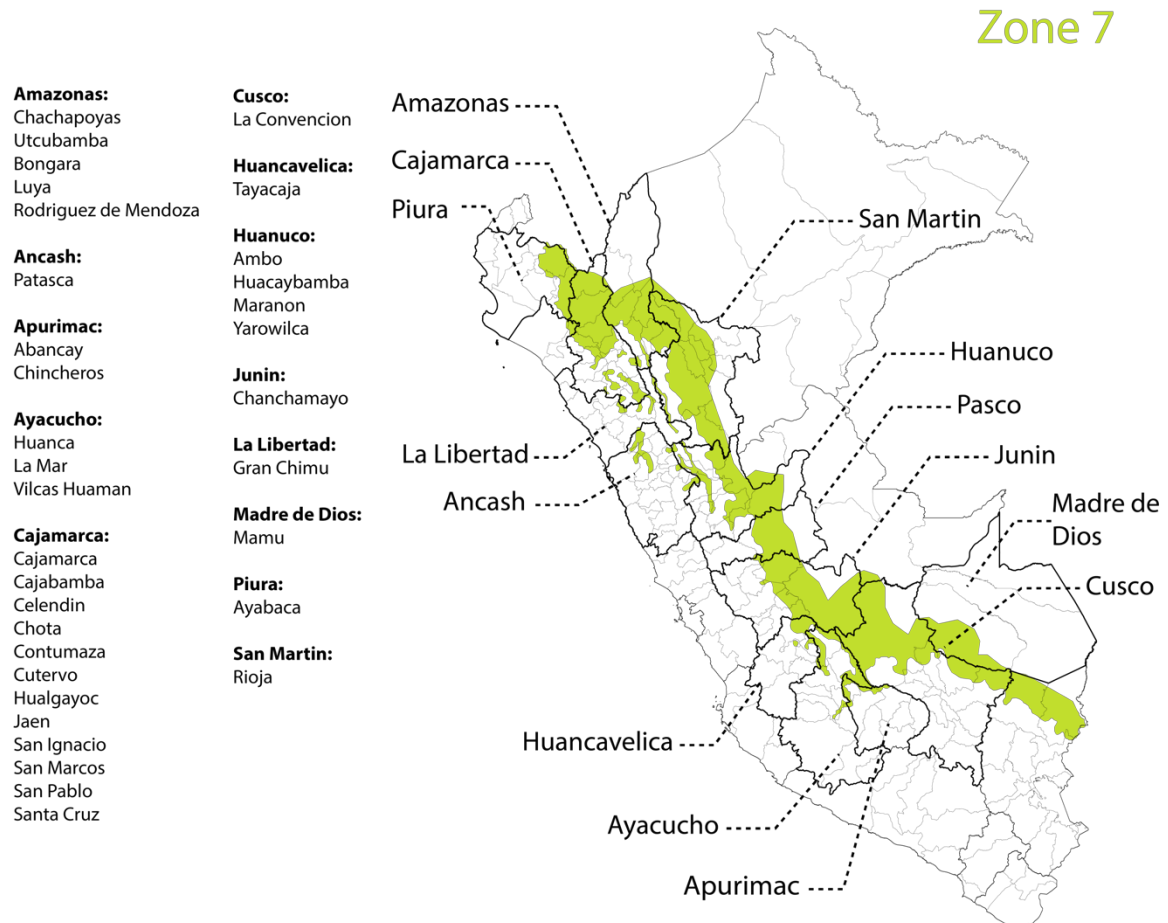


*Figure 44: Amazonian Climatic Zones with Site Locations (by Author)*

In order to narrow down the location of the site within the climatic zone, all the regions that fall under the climatic region have been compared on a basis of the amount of educational facilities that they contain that have problems of access to electricity, water, and sanitation, and by comparing the infrastructure gap per region, more specifically, their need of rural infrastructure. Within those regions, the specific sites were selected based on the Ministry of Education of Peru's identification of populated areas that do not contain an educational facility, as they've identified them based on their educational census data gathered by ESCALE (Estadística de la Calidad Educativa or Statistics of Educational Quality). Below is a closer look per site.

Location 1: Zone 7, Region: Cajamarca; Province: Jaen; City: Jaen (potential as site 3)

Figure 45: Regions and Provinces in Zone 7 (by Author)



Within all of the regions in the Mountain Brow Zone (Zone 7), Cajamarca is chosen as a potential for site 3 for future deployability. It is the region with the largest amount of schools with problems of access to electricity, water and basic sanitation, along with being the region with the highest need of rural infrastructure. Cajamarca is also the department of highest poverty rates, which fluctuate between 52.3% and 47.4%.

## Cajamarca Region



*Figure 46: Jaen Province Located in Cajamarca Region (by Author)*

Location 2: Zone 8; Region: Junín; Province: Satipo; City: Satipo

## Zone 8

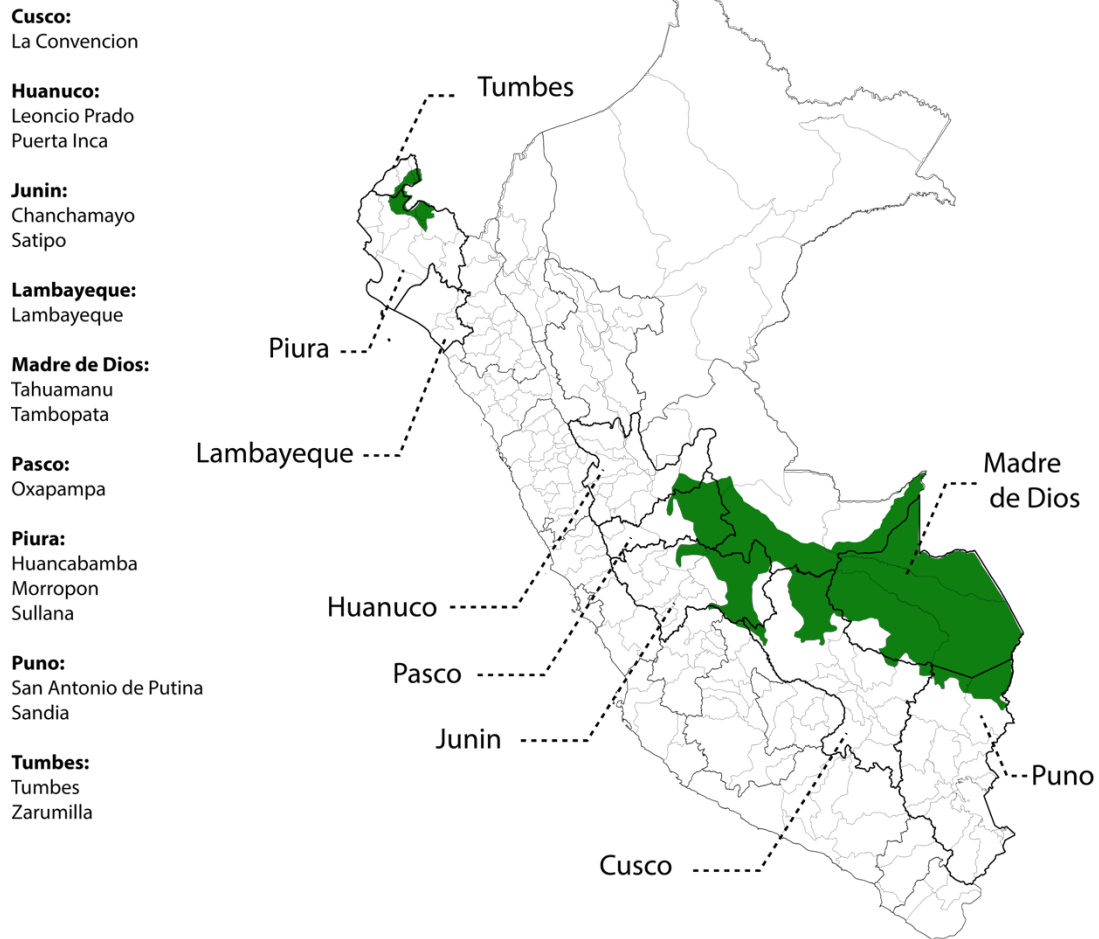


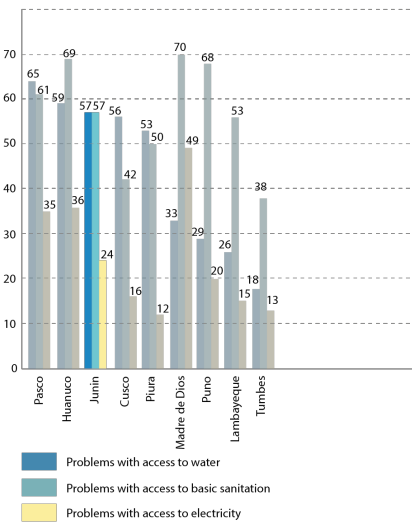
Figure 47: Regions and Provinces in Zone 8 (by Author)

## Junin Region



Figure 49: Satipo Province Located in Junin Region (by Author)

**Educational facilities with problems of access to electricity, water, and sanitation in Zone 8, by region (%)**



**Infrastructure gap in Zone 8, per region, per rural and urban areas (in millions of peruvian soles)**

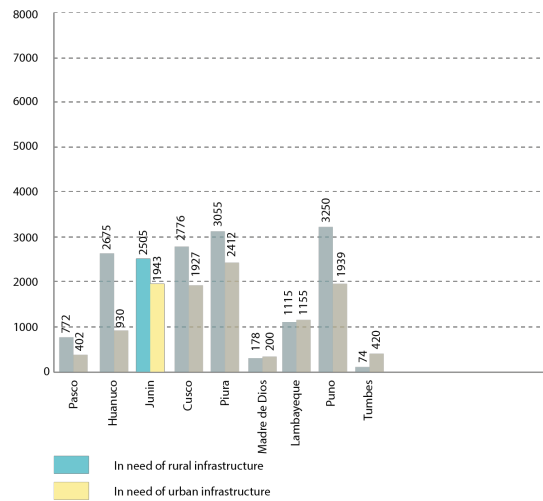


Figure 48: State of Educational Facilities by Region (by Author based on information from MINEDU)

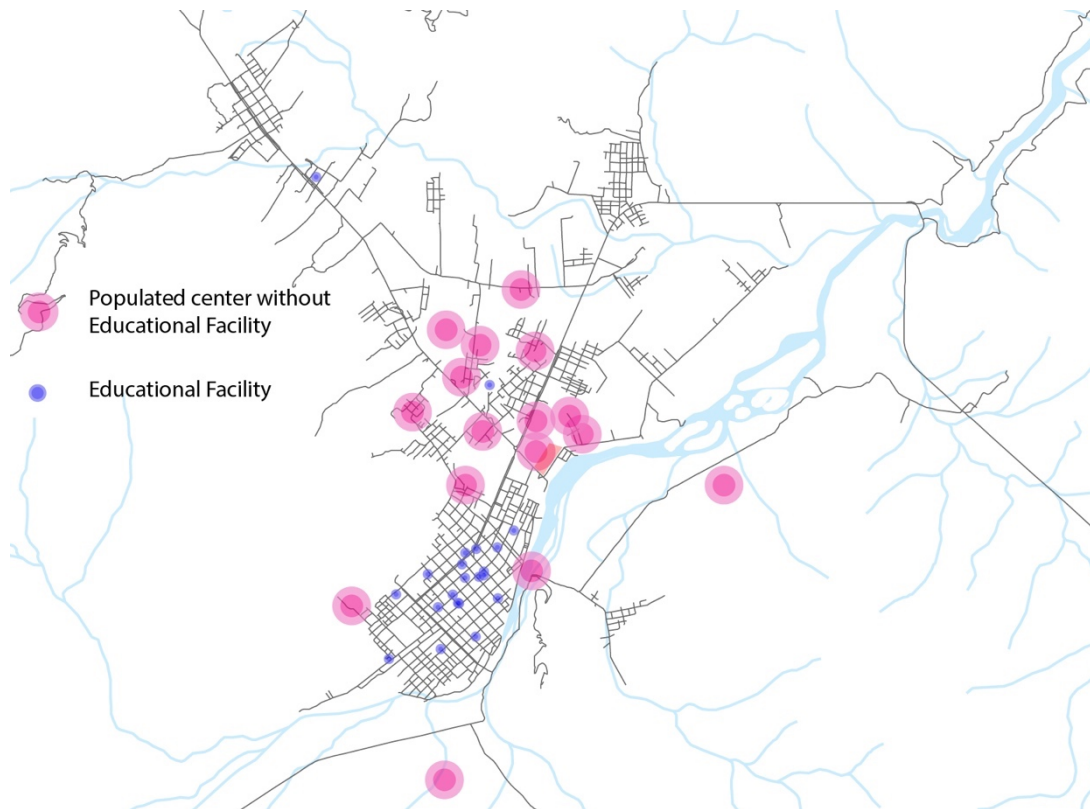


Figure 50: Populated Areas without an Educational Facility (by Author)

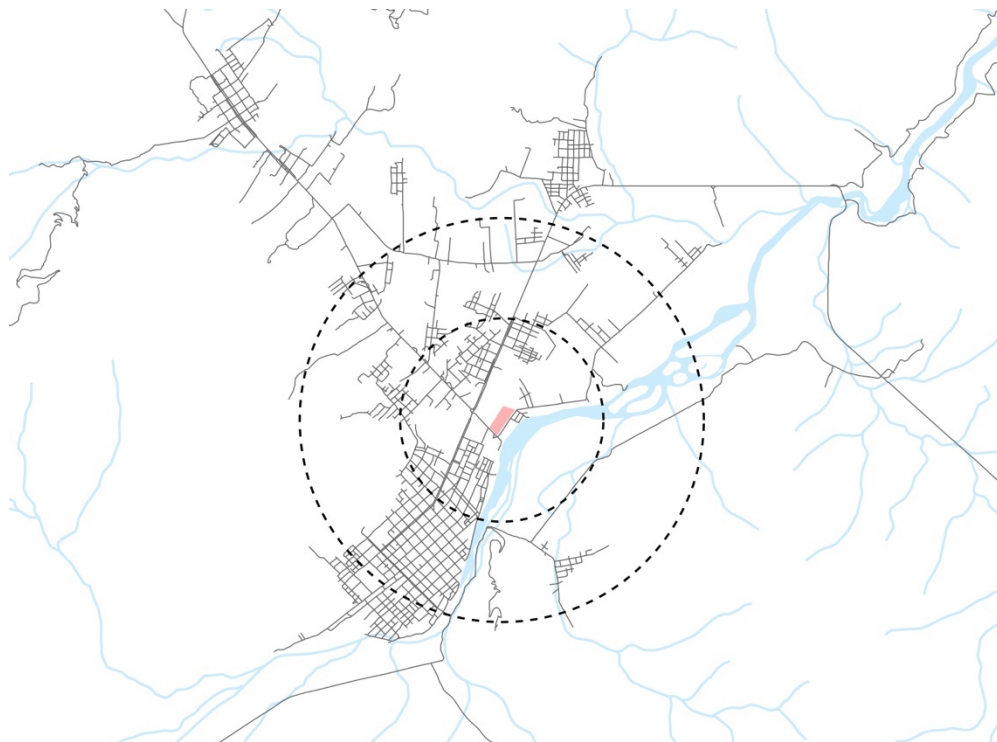
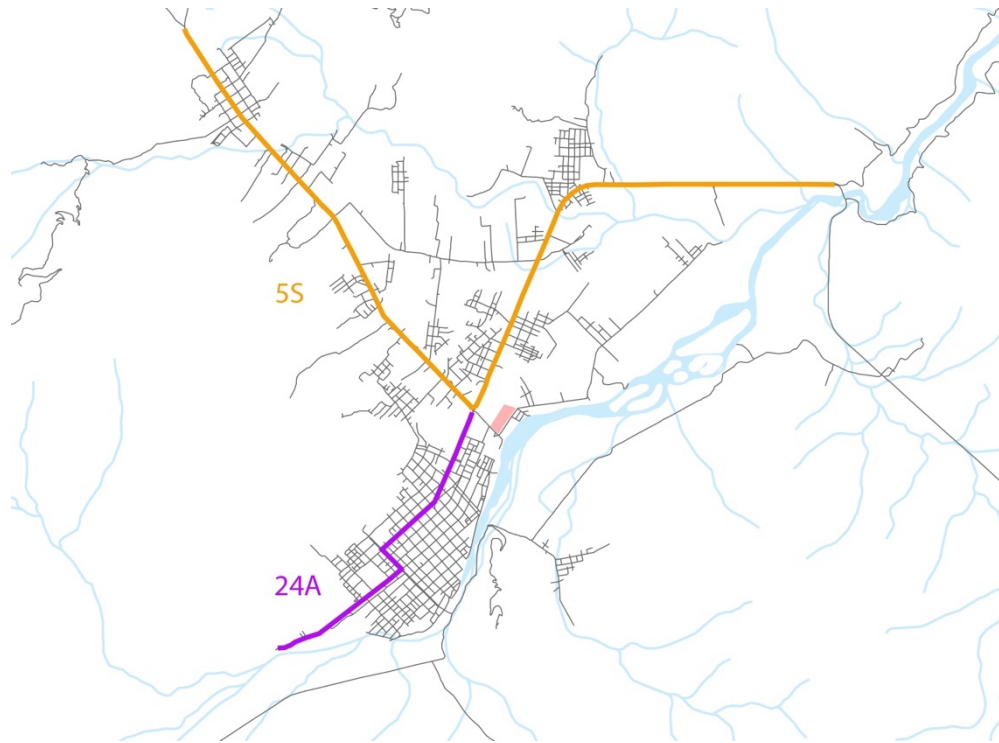


Figure 51: Satipo 10 minute walking radius (by Author)



*Figure 52: Regional Roads (by Author)*

Location 3: Zone 9; Region: Loreto; Province: Mayna; City: Iquitos

## Zone 9

**Amazonas:**

Bagua  
Condorcanqui

**Loreto:**

Maynas  
Alto Amazonas  
Loreto  
Mariscal Ramon Castilla  
Requena  
Datum del Marañon  
Ucayali

**San Martin:**

Bellavista  
Mariscal Caceres  
San Martin  
El Dorado  
Huallaga  
Lamas  
Moyobamba  
Picota  
Tocache

**Ucayali:**

Purus  
Padre Abad  
Atalaya  
Coronel Portillo



*Figure 53: Regions and Provinces in Zone 9 (by Author)*

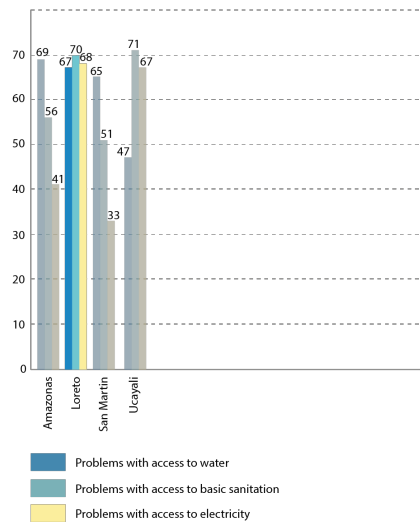


## Loreto Region



Figure 55: Maynas Province Located in Loreto Region (by Author)

**Educational facilities with problems of access to electricity, water, and sanitation in Zone 9, by region (%)**



**Infrastructure gap in Zone 9, per region, per rural and urban areas (in millions of peruvian soles)**

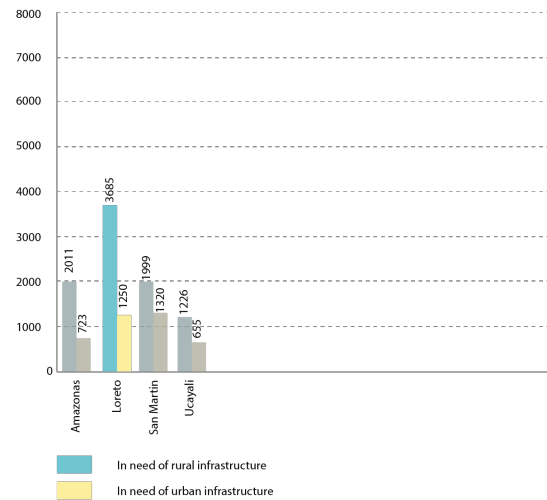
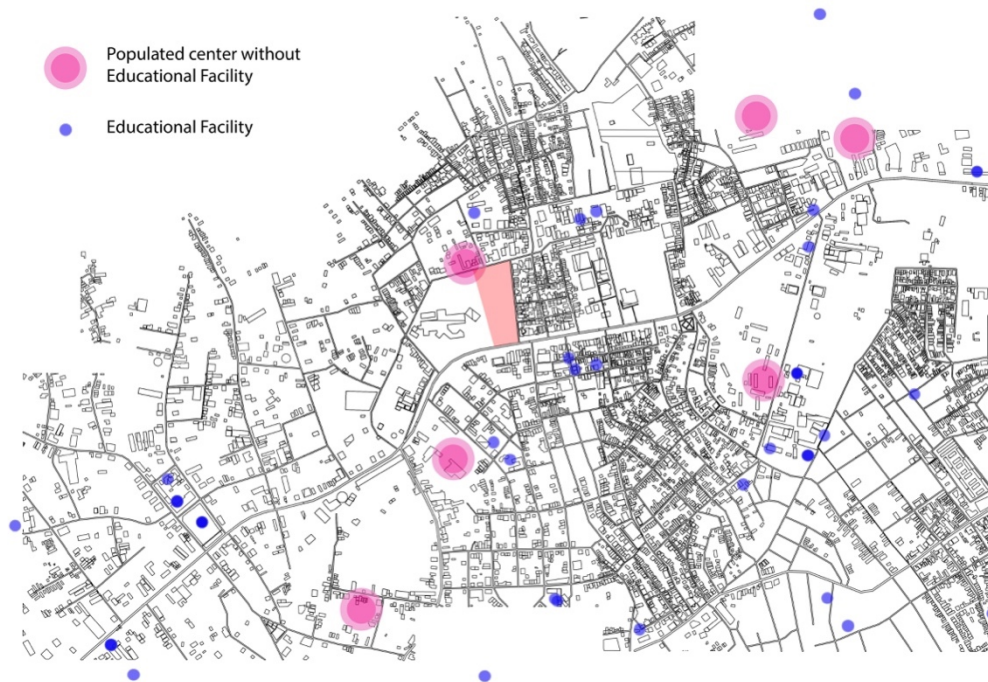


Figure 54: State of Educational Facilities by Region (by Author based on information from MINEDU)

Loreto was chosen because at a national level, out of all the regions it has the highest number of educational facilities that have problems with access to electric energy (68%), water (67%) , and sanitation (70%). It is also the number one region in Zone 9 that has the highest need for rural infrastructure.



*Figure 56: Populated Areas without an Educational Facility (by Author)*

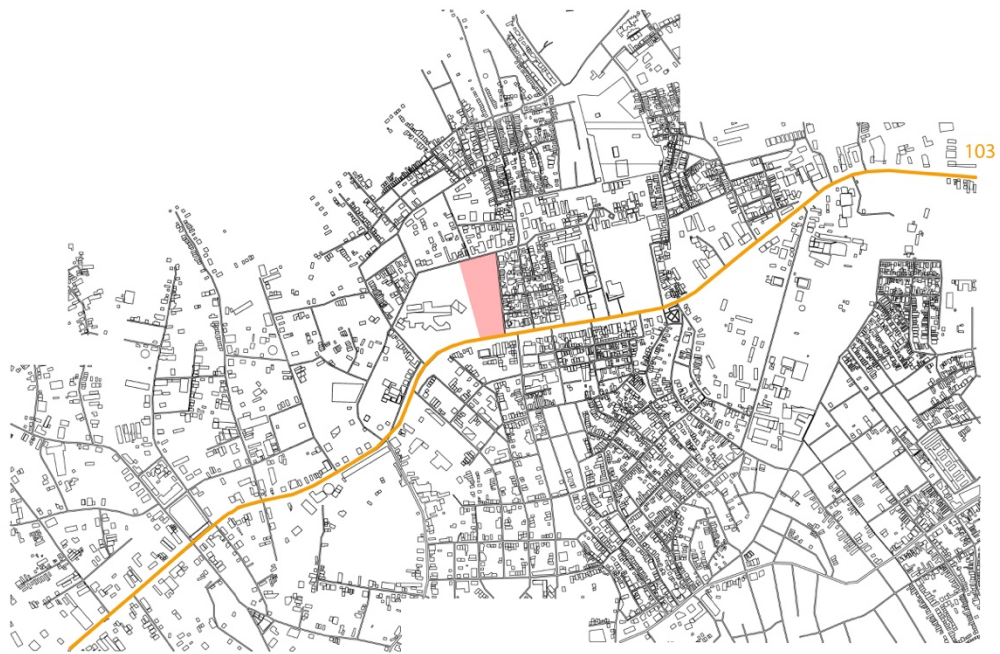


Figure 57: Regional Roads (by Author)



Figure 58: 5 and 10 minute walking radii (by Author)

## Chapter 7: Program

The program for the educational facility has been derived from analysis of schools of similar scale, similar location, and/or similar needs. The main aspect of the program consists of learning spaces. These “classrooms” will be designed to foster the latest teaching pedagogies and for that purpose can be of three different sizes. The largest space is for *shared learning spaces*, the most commonly used will be the typical *learning setting*, and the third will be for *small groups*. This range in sizes will permit a multitude of learning styles that are the basis of the contemporary teaching methodologies. The second most important spaces will be the exterior programable spaces. The landscape elements take equal hierarchy, since they can be used for ecological education, play, connecting to the community, with a mixture of private and public courtyards. Connections to the exterior are vital for producing higher achievements in learning spaces, therefore the application of multiple courtyards will be a key element of the program. The design will explore the connection of important programmatic spaces to these exterior.

A major support space for the programmatic requirement are dormitories. This will allow for students and teachers an opportunity to live on the premises being that the sites considered are rural, often times remote locations.

In an effort to create spaces that will empower communities it is imperative for there to be spaces allocated to community gatherings and training facilities. This aspect of the program will be less formal than the children’s learning spaces, adapted to working adults that are seeking technical and productive knowledge for enhanced performance regarding their trades.

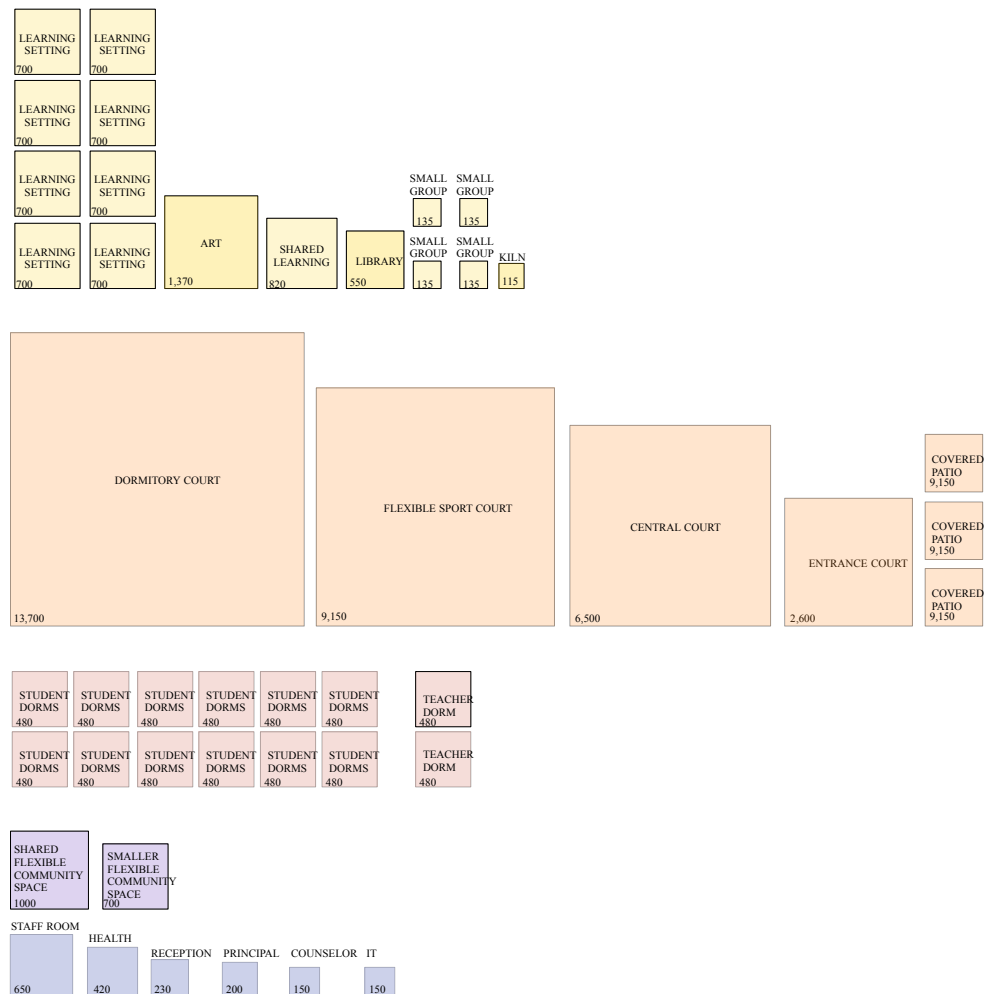
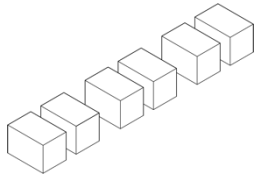


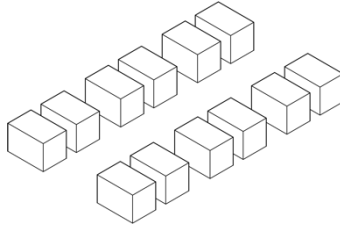
Figure 59: Program elements to scale (by Author)

The programmatic needs of the educational facility will vary based on the selected location for the module. Each aspect will be able to be varied in size which would allow the project to be phased and maintain a flexibility necessary for a deployable and reproduceable model. Depending on how many of the elements are required and what the site restrictions are, the program can be laid out within the 6

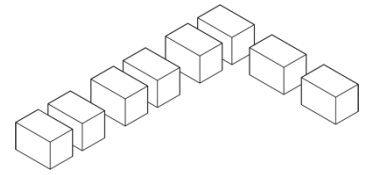
following configurations, as arrived to by precedent explorations precedents of schools with different physical configurations and with different programmatic requirements.



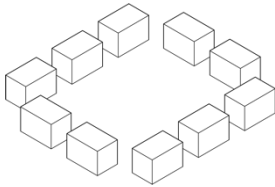
Linear



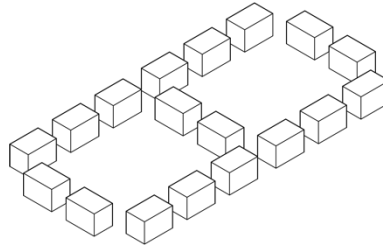
Parallel



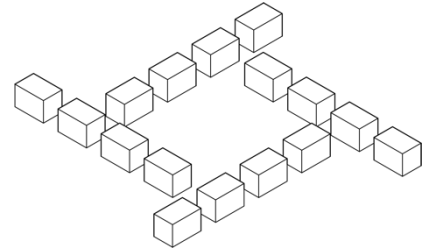
L-Shaped



Central Court



Multiple Courts



Radial

*Figure 60: Layout configurations (by Author)*



## PROPOSED PROGRAM

		SQFT	QUANTITY	TOTAL		
EDUCATIONAL LEARNING SPACES	ART CLASSROOMS	LEARNING SETTING	700	8	5,600	6,960 SQFT
		SHARED LEARNING	820	1	820	
		SMALL GROUP	135	4	540	
		LIBRARY	550	1	226	1,711 SQFT
		ART	1,370	1	1,370	
		KILN	115	1	115	
					8,671 SQFT	
SOCIAL ACTIVITY	FORMAL	ENTRANCE COURT	2,600	1	2,600	22,800 SQFT
		CENTRAL COURT	6,500	1	6,500	
		DORMITORY COURT	13,700	1	13,700	
	INFORMAL	FLEX. SPORT COURT	9,150	1	9,150	10,800 SQFT
		COVERED PATIO	550	3	1,650	
DORM		STUDENTS (FOR 2)	480	12	5,760	6,720 SQFT
		TEACHERS (SINGLE)	480	2	960	6,720 SQFT
COMMUNITY SPACES		SHARED FLEXIBLE	1,000	1	1,000	3,100 SQFT
		SMALLER FLEXIBLES	700	3	2,100	3,100 SQFT
ADMIN		RECEPTION	230	1	230	1,800 SQFT
		PRINCIPAL	200	1	200	
		HEALTH CENTER	420	1	420	
		STAFF ROOM	650	1	650	
		COUNSELOR	150	1	150	
		SHARED IT OFFICE	150	1	150	
					1,800 SQFT	
					X 1.45	
					53,891 SQFT	

**GROSS AREA: 78,142 SQFT**

Figure 61: Proposed program breakdown (by Author)

Precedent 1: Linear: Agricultural School, Bellavista, Bolivia

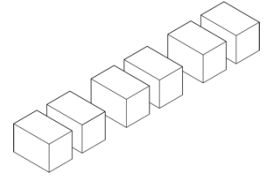


Figure 62: Exterior view of Bellavista Agriculture School (ArchDaily)

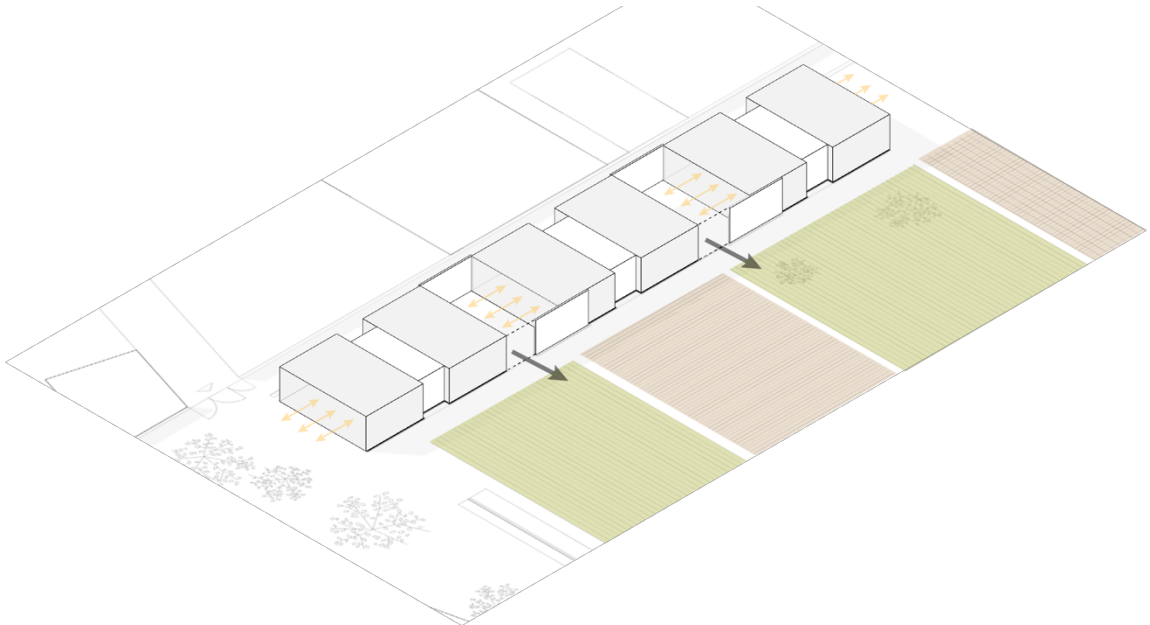


Figure 63: Linear programmatic distribution for Bellavista Agriculture School (by Author)



## Precedent 2: Parallel: Antsipatari School

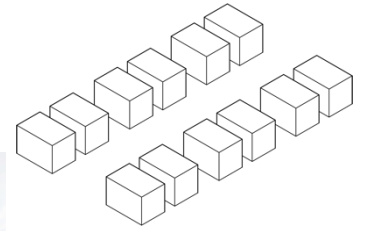


Figure 64: Section through parallel wings, Antsipatari School (ArchDaily)

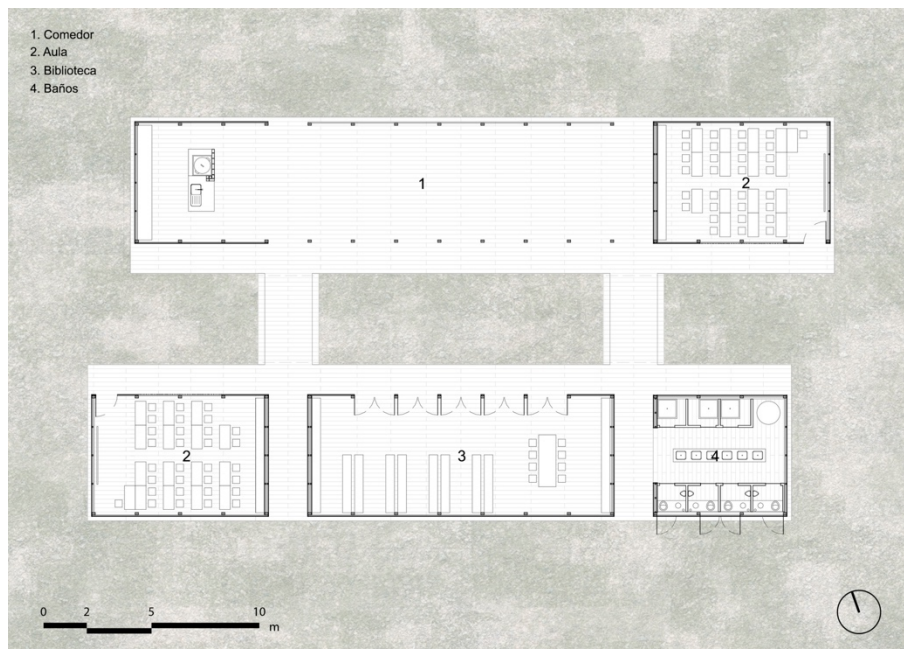


Figure 65: Plan of parallel wings, Antsipatari School (ArchDaily)

### Precedent 3: L-Shape: Jerusalem de Miñaro Primary School

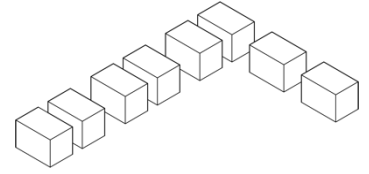


Figure 66: Exterior view, Jerusalem de Miñaro Primary School (ArchDaily)

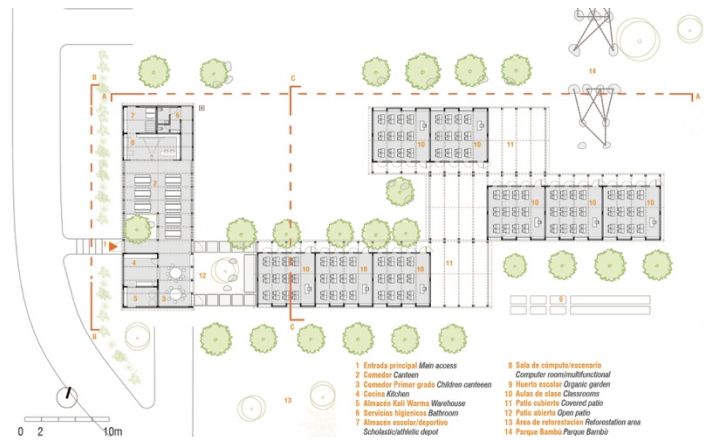


Figure 67: L-Shape plan at Jerusalem de Miñaro Primary School (ArchDaily)

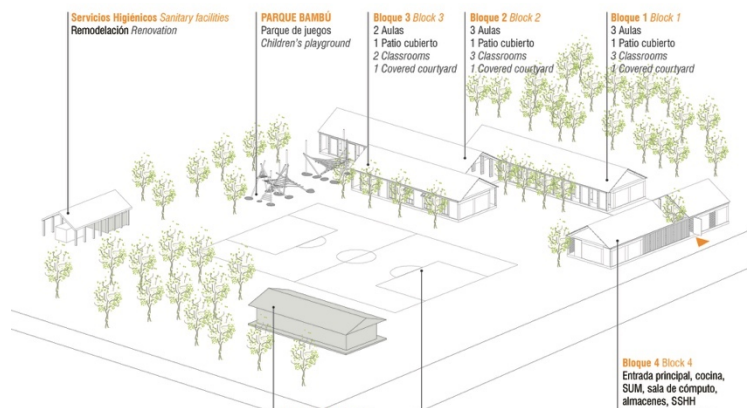


Figure 68: Isometric view of Jerusalem de Miñaro Primary School (ArchDaily)

Precedent 4: Central: Ulyankulu School, Tanzania

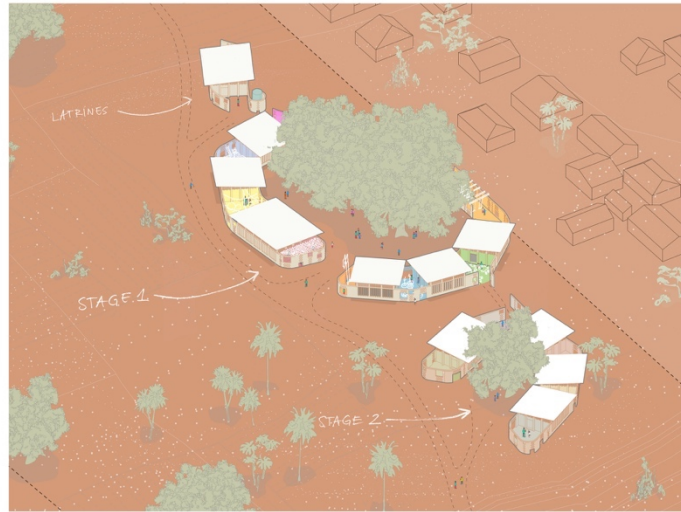
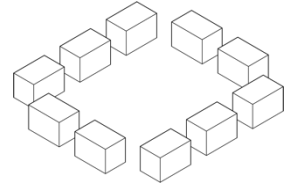


Figure 69: Site planning, Ulyankulu School (ArchDaily)

This organization allows for all activities to be centered around a main space. It can be good for safety and supervision from teachers. The inner central courtyard design for the new school in Ulyankulu, Tanzania by WAYAiR creates an “educational village” that offers an art based educational program. It accommodates social activities for students during school and after hours, encouraging play between the students and others in the town.



Figure 70: Classroom at Ulyankulu School (ArchDaily)



## Precedent 5: Multiple Courts : Aumazo

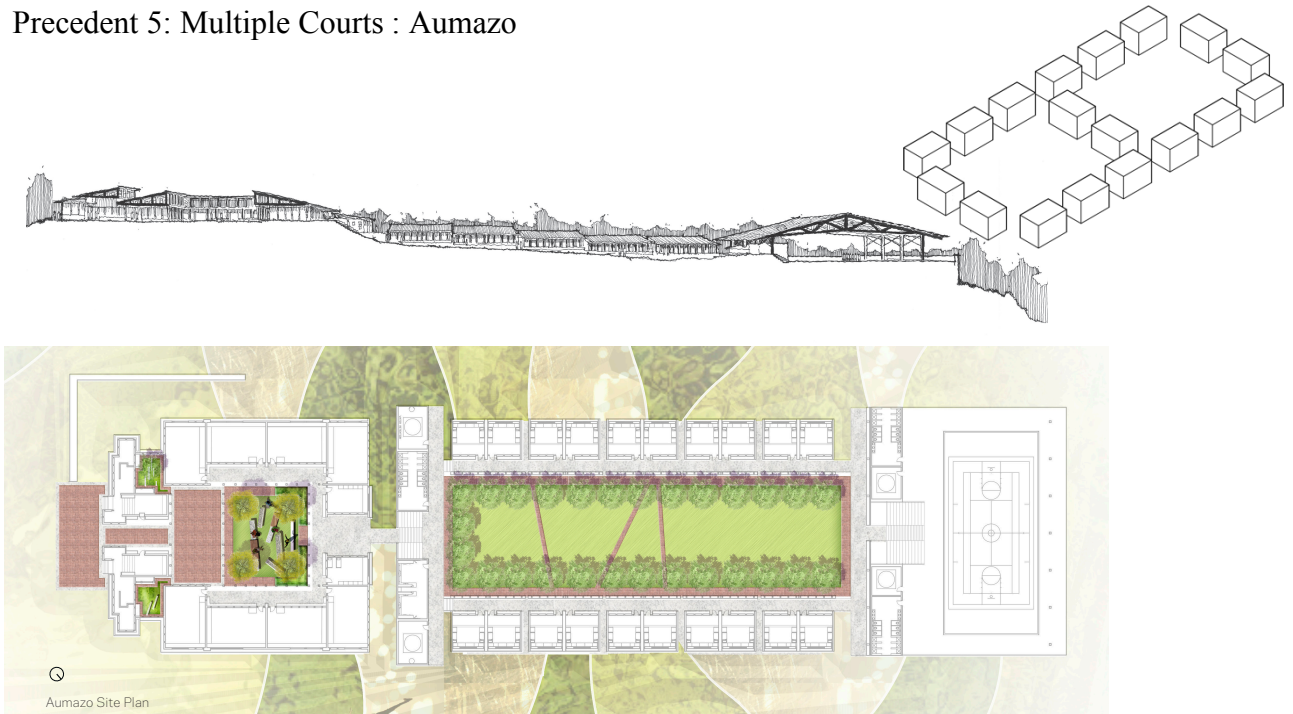


Figure 71: Multiple Courts Plan, Aumazo School (HO+K Architects)

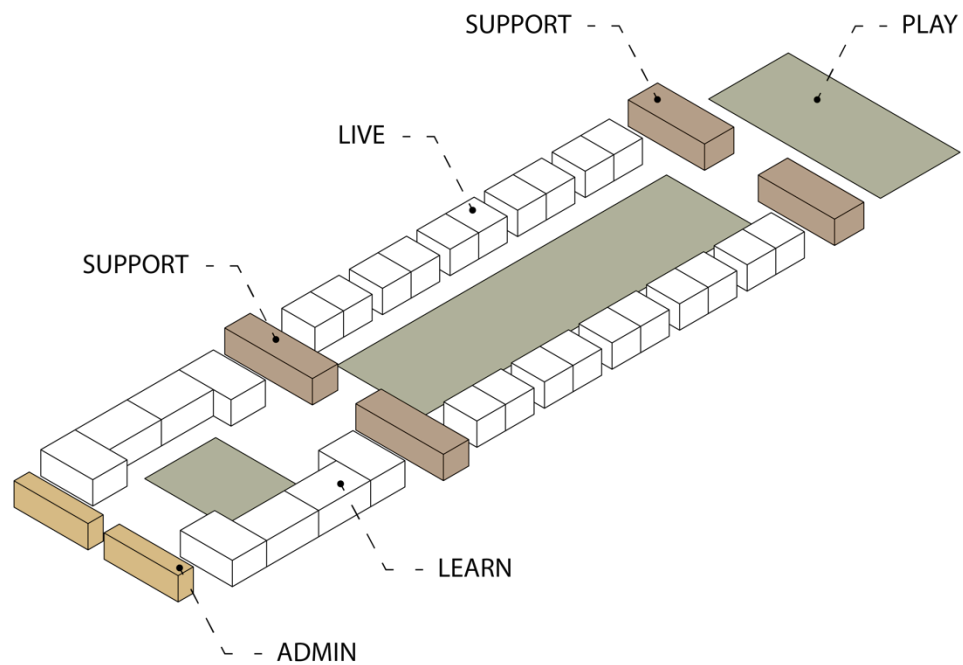


Figure 72: Program distribution, Aumazo (by Author)

Precedent 6: Radial: School in Chuiquibambilla

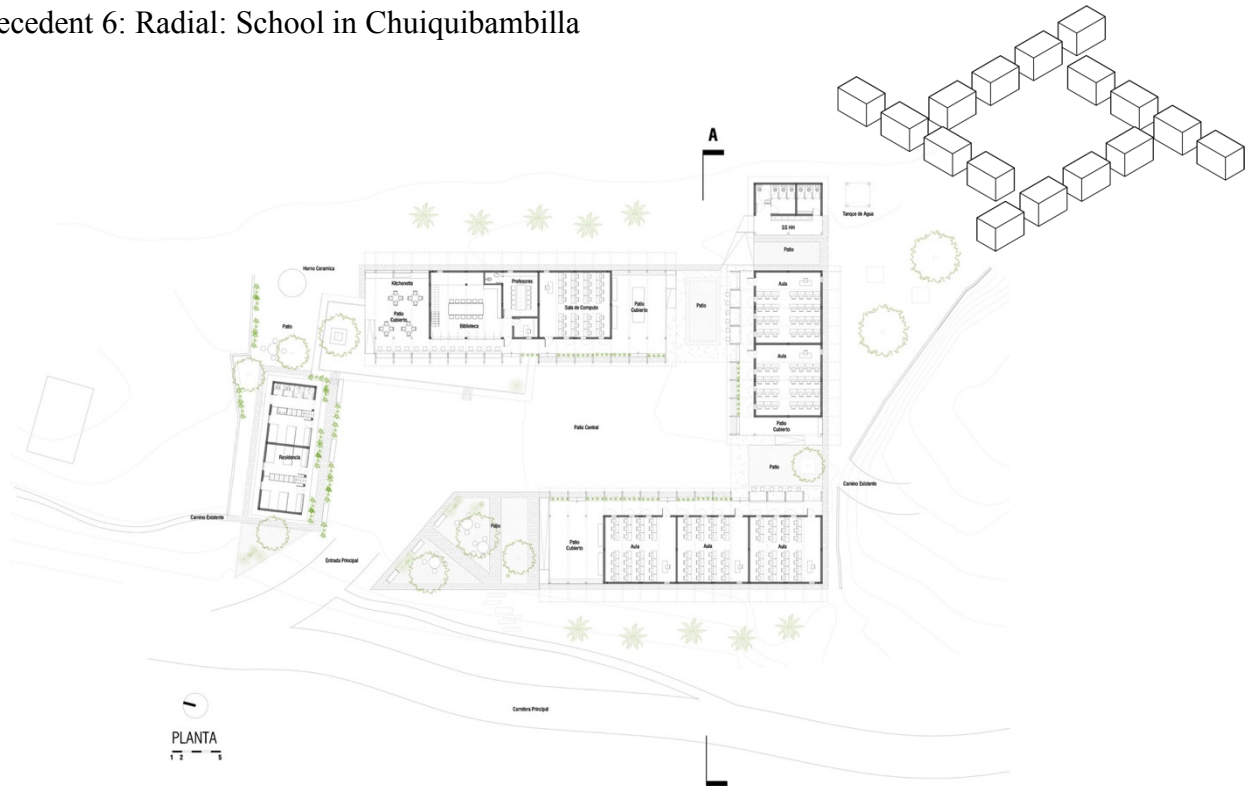


Figure 73: Radial Plan, Chuiquibambilla School (ArchDaily)



Figure 74: Exterior Courtyards, Chuiquibambilla School (ArchDaily)

Learning outcomes from precedents:

The analysis of schools at multiple scales, in different locations, and with different parts have resulted in multiple different applicable design principles that can be repurposed within the design of this thesis.

Bellavista: Interstitial spaces can be functional. Space between classrooms can be used to turn traditional learning spaces into a secondary type of learning spaces.

Jerusalen de Miñaro: The thickness of masonry walls can be taken advantage of. Storage space can be built into the structure of the modular space.

Aumazo: The organization of a campus into separate zones is critical in order to provide separation between different programmatic needs and for the creation of privacy for residential zones.

Ulyankulu: The use of a central landscaping element within a courtyard can be practical and functional in many ways. Not only would a large canopy provide identity to a courtyard and act as an organizing element but can provide an area of shaded space for outdoor learning. The proximity of natural landscape to classrooms also provides cooler air for improved natural ventilation.

Chuiquibambilla: Loggia spaces can be a tertiary learning space.

Precedents that were also studied but not included in this document include but are not limited to the following list: Children Village by Aleph Zero, Schools by Plan: B Arquitectos, Nakuru Project by Orkidstudio, Primary School in Gando by Kere Architecture, and Sra Pou Vocational School by Architects Rudanko + Kankkunen.

## Chapter 8: Architectural Response

### Site Strategies:

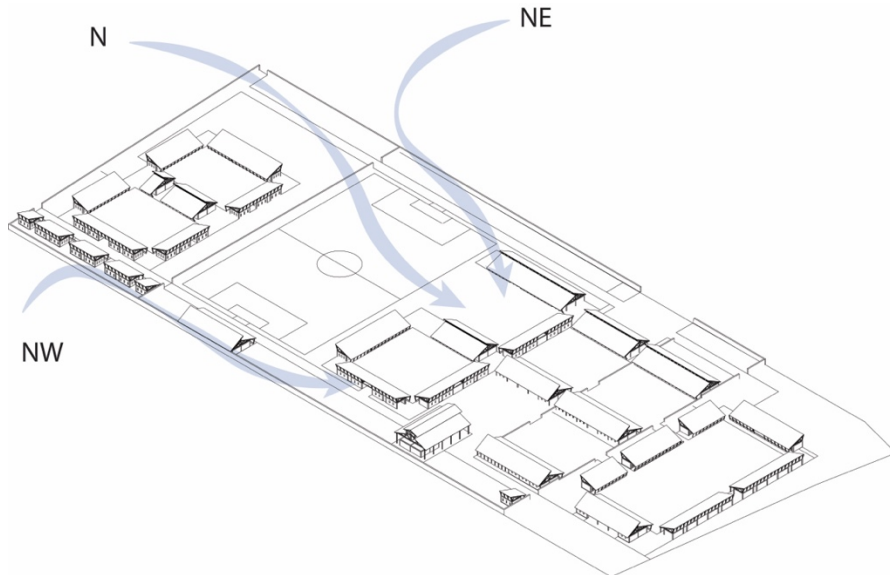


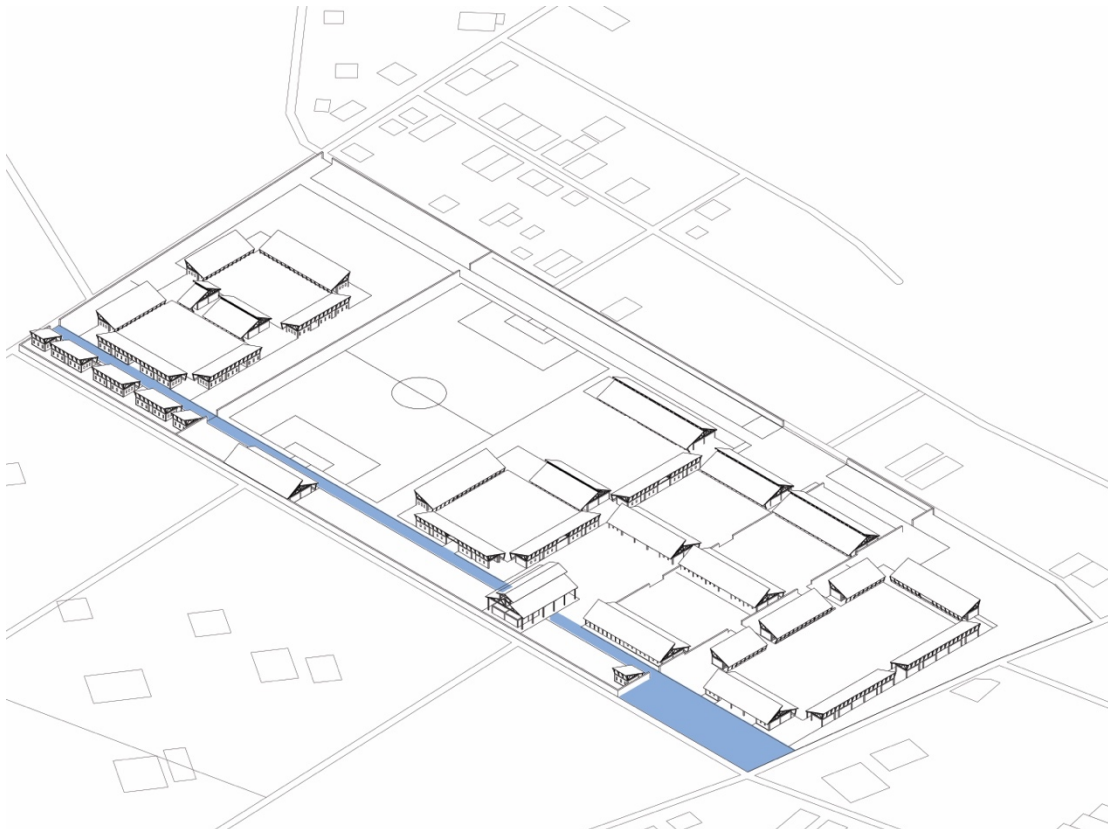
Figure 75: Prevalent Winds on Site (by Author)



Figure 76: Sun Paths on Site (by Author)



The predominant winds on the site coming from the North, North-East and North-West make the Southern, Eastern, and Western buildings in each courtyard the most comfortable in terms of natural ventilation. Since the sun path in the Southern Hemisphere travels on the northern part of the site, the southern buildings are preferred in order to take advantage of having more openings creating ambient light in classrooms. Both of these facts combined locate the more used parts of the program on these sides, including the dorms and classrooms.

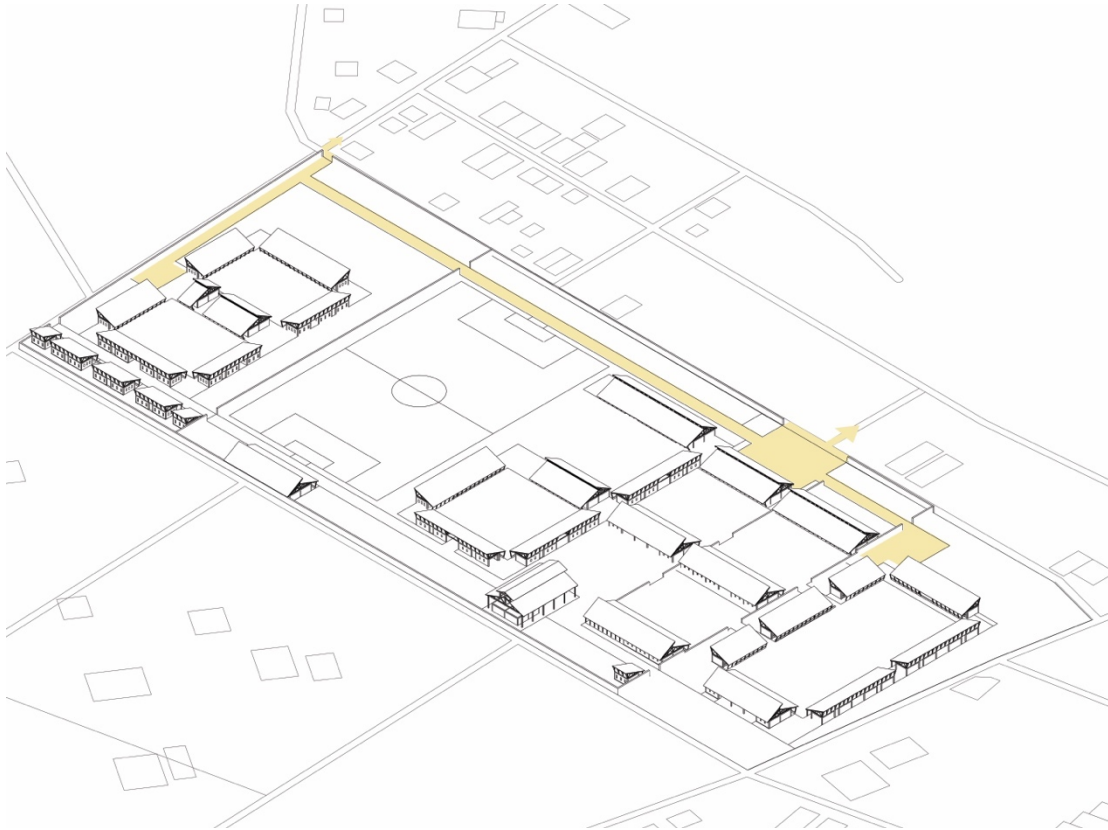


*Figure 77: Main Corridor (by Author)*

The site is organized based on a main corridor with courtyards stemming off from it. From the main entrance onto the site a visitor would first encounter the community adult learning classrooms before facing the main gate for the campus. The main corridor passes through the main gathering pavilion and leads visitors to the



classroom courtyard and soccer pitch before encountering a secondary gate in front of the dorm courtyard. Juxtaposing this main circulation corridor is the service access corridor that runs parallel to it on the site. This corridor provides service entries directly adjacent to the cafeterias located in each court, and lead out into existing roads around the site, away from the main pedestrian entrance.



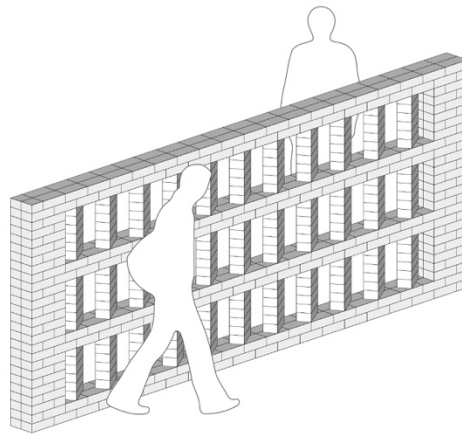
*Figure 78: Service Corridor (by Author)*

### Wall Types:

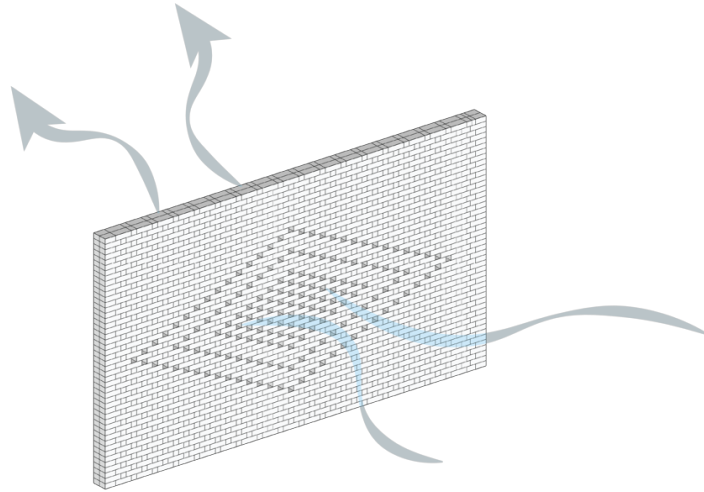
The perimeter of the campus is lined with a porous brick wall that provides safety while still allowing a visual connection to the exterior and vice versa. This provides a sense of safety and enclosure while still allowing students to see the

surrounding neighborhood and for the community to still be able to get a glimpse of some of the student activities in the more public courtyards.

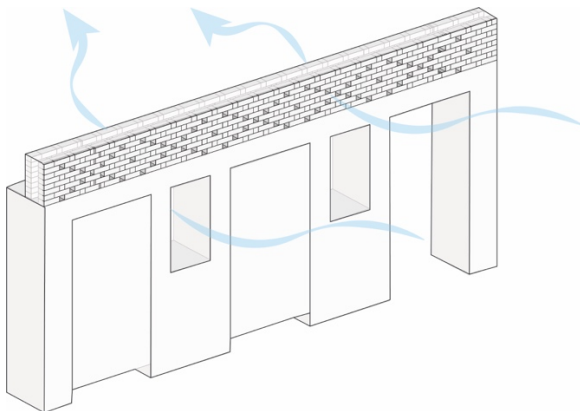
Two other additional wall types were designed in order to maximize the amount of natural ventilation in interior spaces throughout the campus. These are brick walls with a Flemish bond pattern with specific bricks removed in order to compose patterns that are symbolic in the native indigenous Ashaninka community. When deploying the model, this pattern can be modified to accommodate designs local to the specific community they serve.



*Figure 79: Perimeter Wall (by Author)*

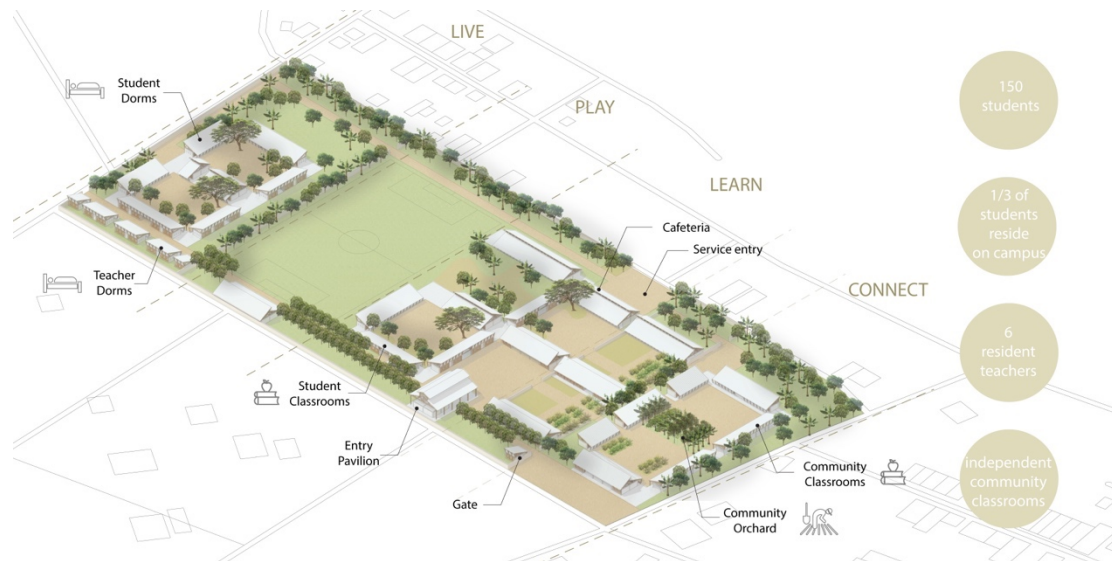


*Figure 80: Ventilation Pattern on Side Walls (by Author)*



*Figure 81: Additional Ventilation (by Author)*

### The Program:



The program is separated into four zones, Live, Play, Learn and Connect. The Play zone acts as a security and visual buffer between student and teacher residents from the academic buildings on campus. Live zone also has its own cafeteria and outdoor courtyard for students and teachers to have space in which they can relax in. Learn and Connect zones are intertwined since parts of both of these zones can be used for students as well as for community adult learners.



Figure 83: Site Plan (by Author)



Within the entry sequence to campus one passes a community building that opens its loggia into the public plaza that students get dropped off at and can sit around in until they enter campus. A café is located within this entry building for students and community members alike to meet at before classes start. Upon entry into campus one can begin to see the different building types and components that make up the kit of parts of the model of the campus.



*Figure 84: Main Entrance into Campus (by Author)*



Figure 85: Students Approaching Entry Pavilion (by Author)

Kit of Parts:



Figure 86: Kit of Parts (by Author)

The kit of parts that makes up the model includes a larger module and a smaller module. The smaller module accommodates classrooms and dorms and are designed in a way that can be arranged either abutting each other to make independent spaces or separated by the length of a module in order to create a covered space for flexible usage.

Both modules are built from cast in place reinforced concrete infilled with locally made brick with specifically located openings for ventilation. Then they are topped with locally and sustainably sourced Quinilla Hardwood trusses and purlins that are lined on the interior with woven palm leaf screens. A 2x8 purlin size was chosen because of its height in order to act as insulation and a buffer for the heat that would inevitably be created by sun casting on the corrugated metal. All interior furniture and louvers use Capirona Softwood.



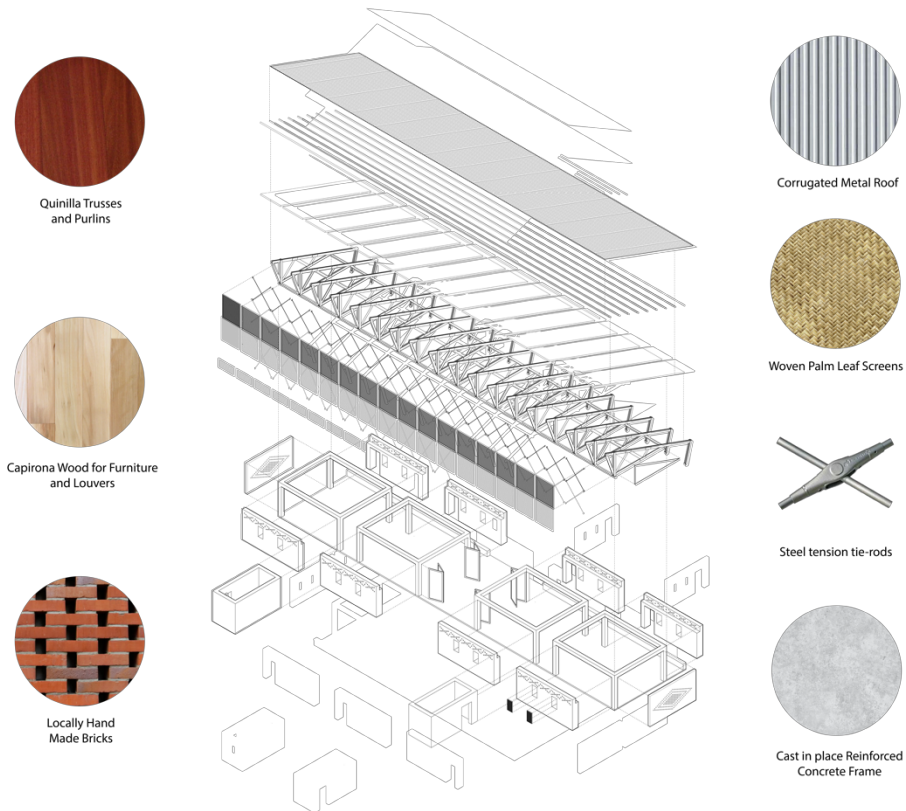


Figure 87: Smaller Module - Parts (by Author)

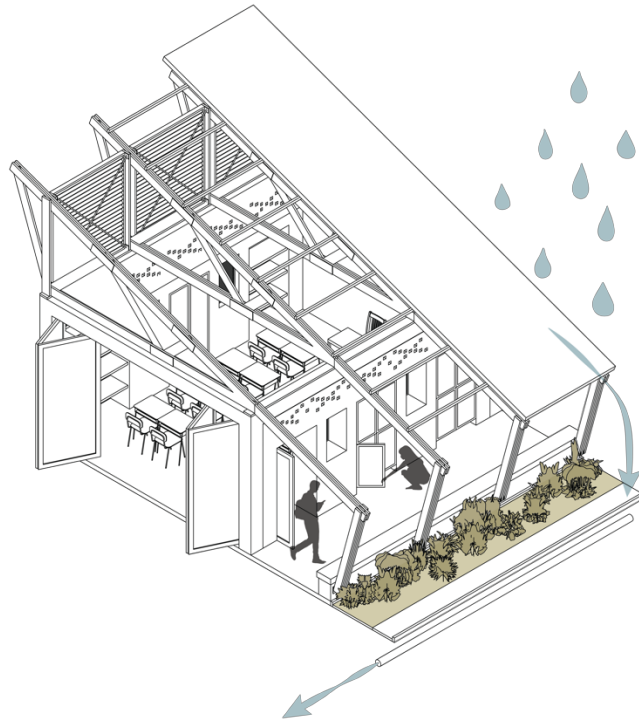
The roof overhang of both modules creates a covered a loggia on the courtyard side of the building for circulation between buildings, and space for students to sit and rest between classes. The classroom modules are lined with lockers within the courtyard. In the dorm module the same thickness of the wall is used as closet space for residents and accessed from the interior. The basic module is 5m x 6m and can comfortably fit 16 students within the classroom set up and 4 students in bunkbeds within the bedroom set up.



Figure 88: Smaller Module - Typical Classroom (by Author)

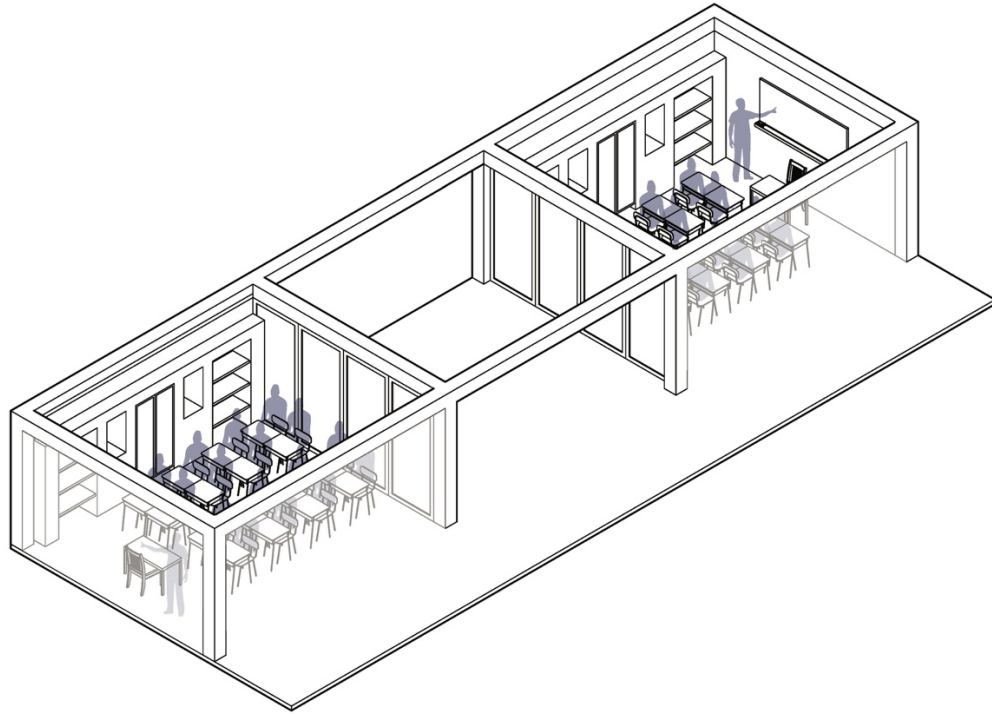


Figure 89: Smaller Module - Flexible Classrooms (by Author)

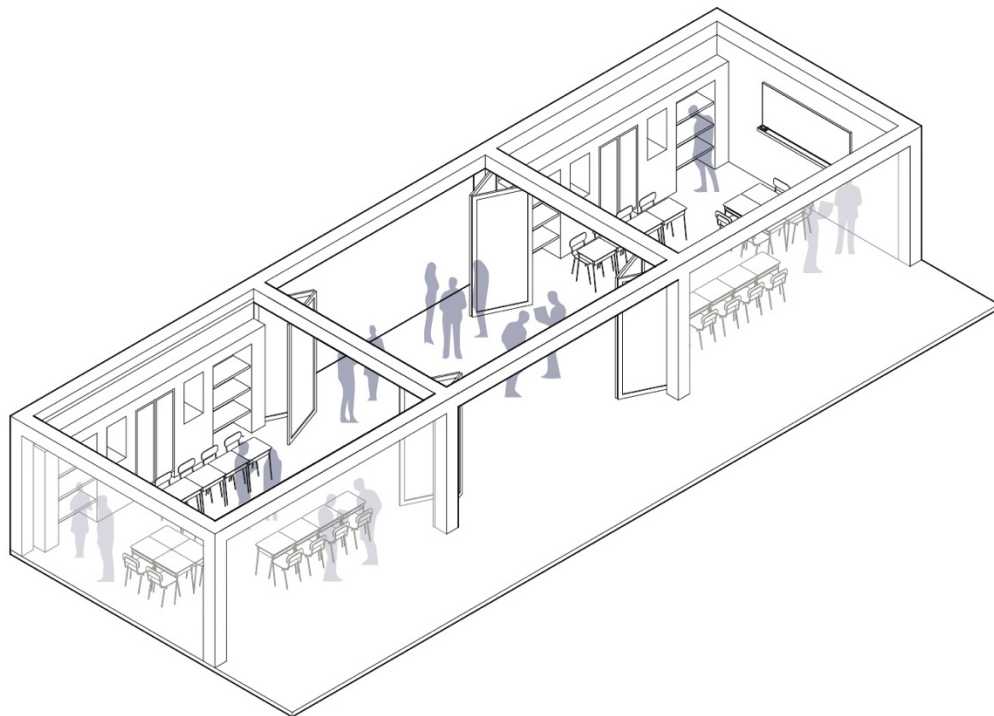


*Figure 90: Smaller Module - Water Collection System (by Author)*

The roof overhangs into a water collection pebble and local plant strip along the buildings that collects the water and gathers it on site in cisterns for later use. The water can be used for irrigation of the orchard in the community courtyard and for crop plants around the site.

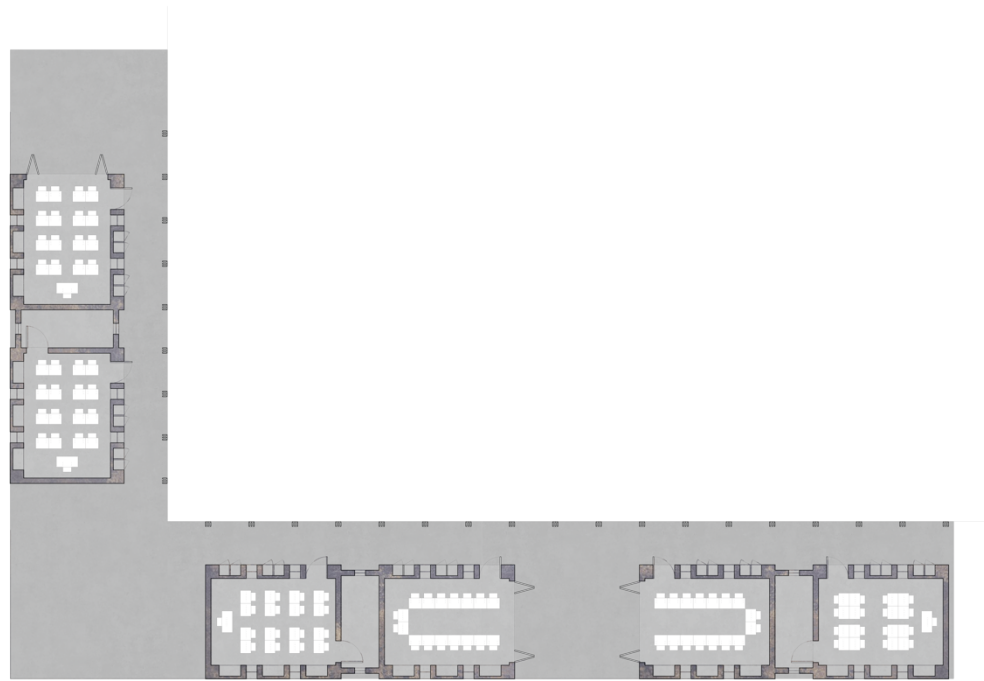


*Figure 91: Smaller Module - Closed Classrooms (by Author)*



*Figure 92: Smaller Module - Open Classrooms (by Author)*

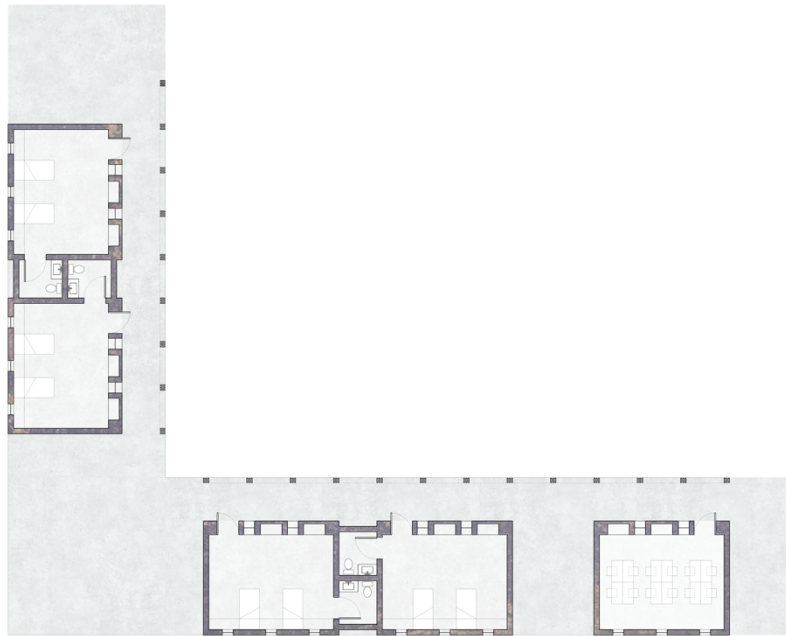
The classroom module is flexible and can adjust in order to create differing sizes of learning spaces for a varied type of activities and can accommodate different learning types. The flexible partitions that cap the classrooms also allow for a more ventilated space and a way of creating formal outdoor learning spaces.



*Figure 93: Smaller Module - Classroom Floor Plan (by Author)*

Dorms use this same module and are also organized in sets of two but have lengths of a full module separating them from a study room. This allows students a space to work after hours without distracting the roommates. Each study room fits three bedrooms' worth of students comfortably. Each bedroom has direct access to half bathroom for easy access but requires students to go to a common wash house that's housed under a different roof within their gender divided courtyard.

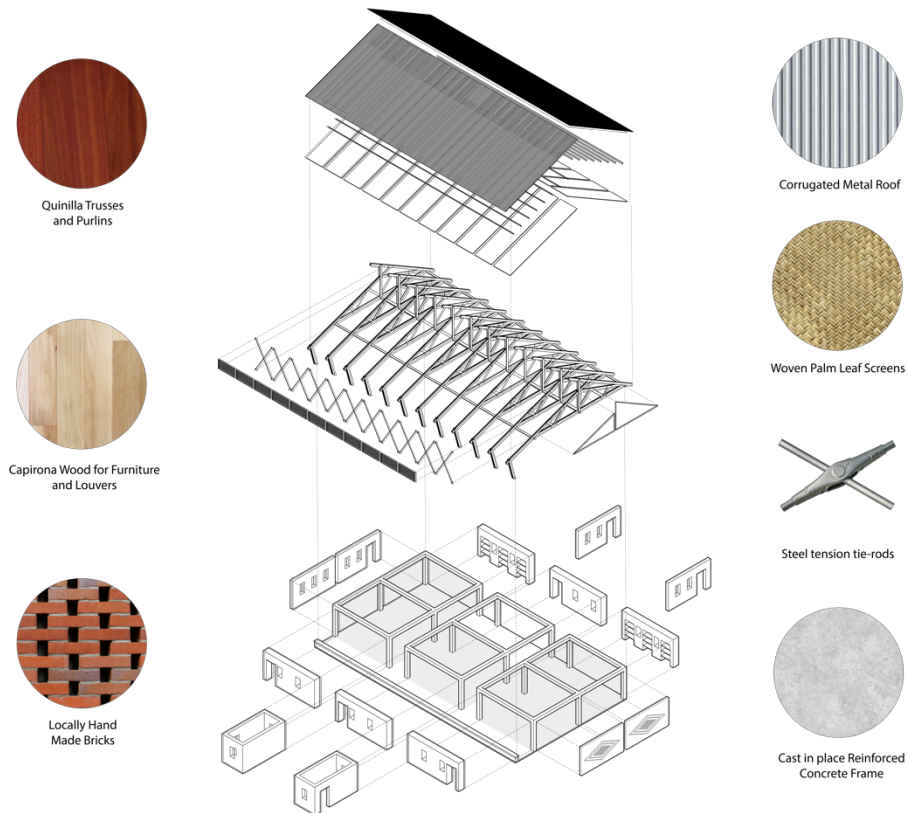




*Figure 94: Smaller Module - Dorm Floor Plan (by Author)*



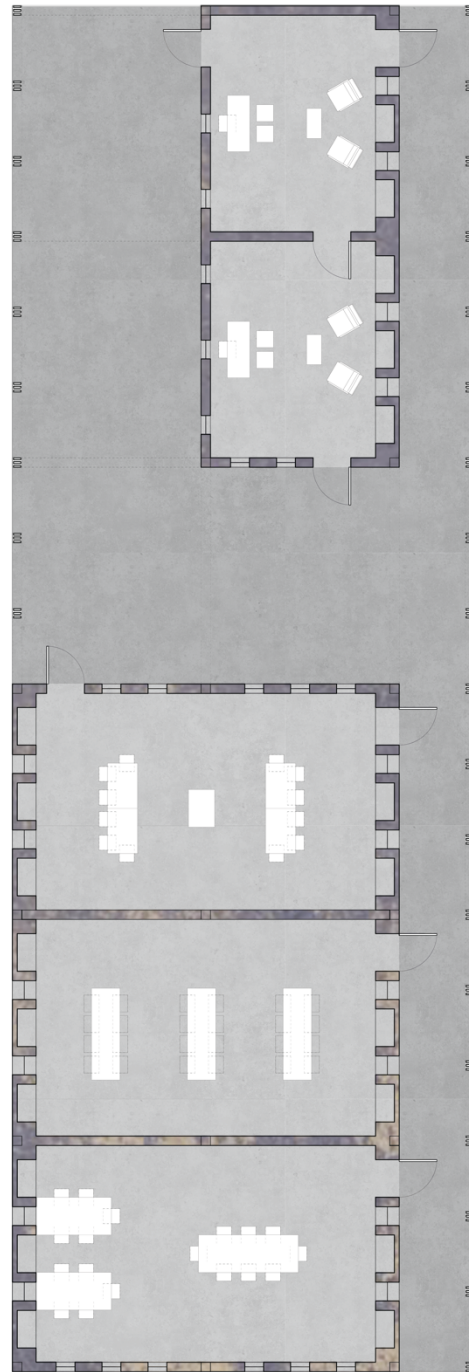
*Figure 95: Smaller Module – Dorms (by Author)*



*Figure 96: Exploded Axonometric for Larger Module (by Author)*

The larger module accommodates programmatic spaces that would not fit within the smaller module such as the library, vocational classrooms, administrative office, and art and science labs. The program in these spaces can also just as easily bleed into outdoor learning spaces. Because the larger module is exactly twice the size of the smaller module the smaller one can easily be inserted within the larger roof canopy and can provide a mixture of spaces for even more flexibility, such as is the case in the administrative/vocational combination plan. Because there are covered gaps between groupings of classrooms or dorms there are many access and

connection points between courtyards.



*Figure 97: Larger Module - Vocational and Administrative Office Floor Plan (by Author)*



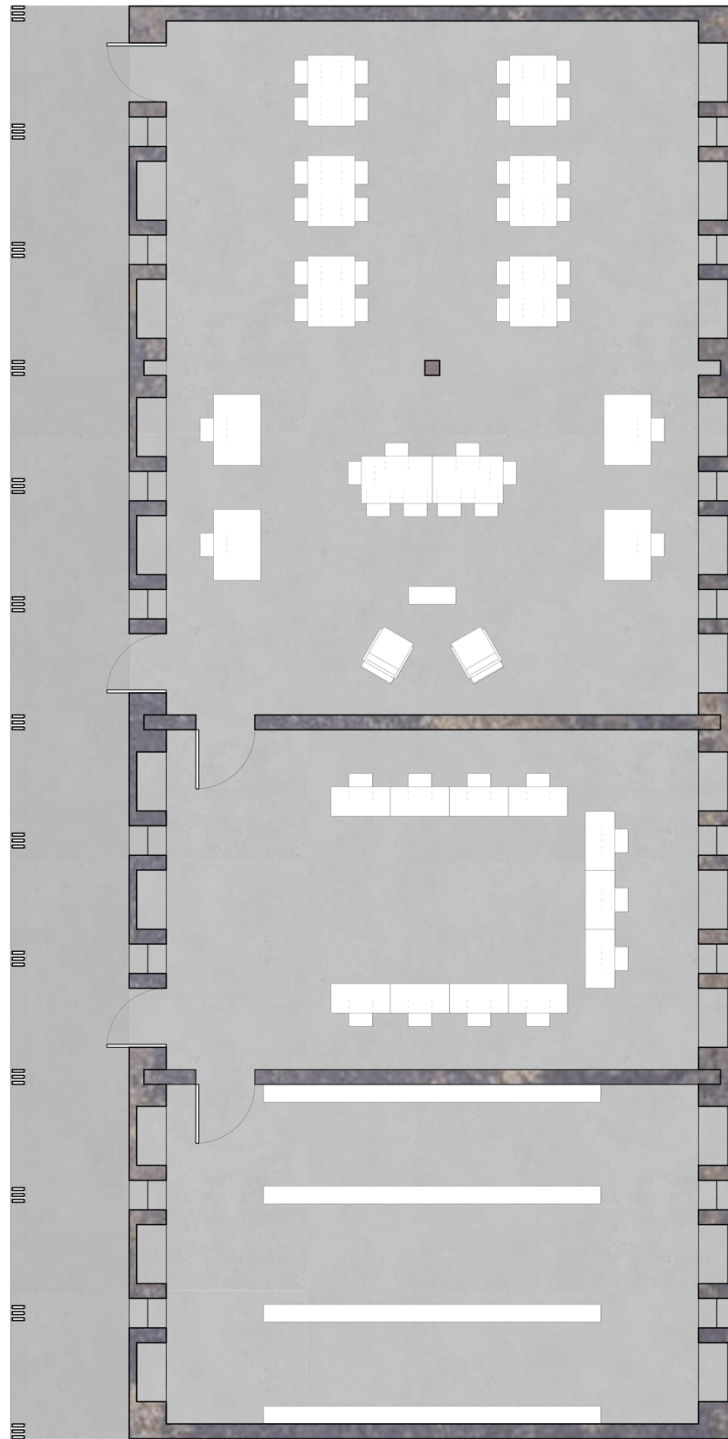
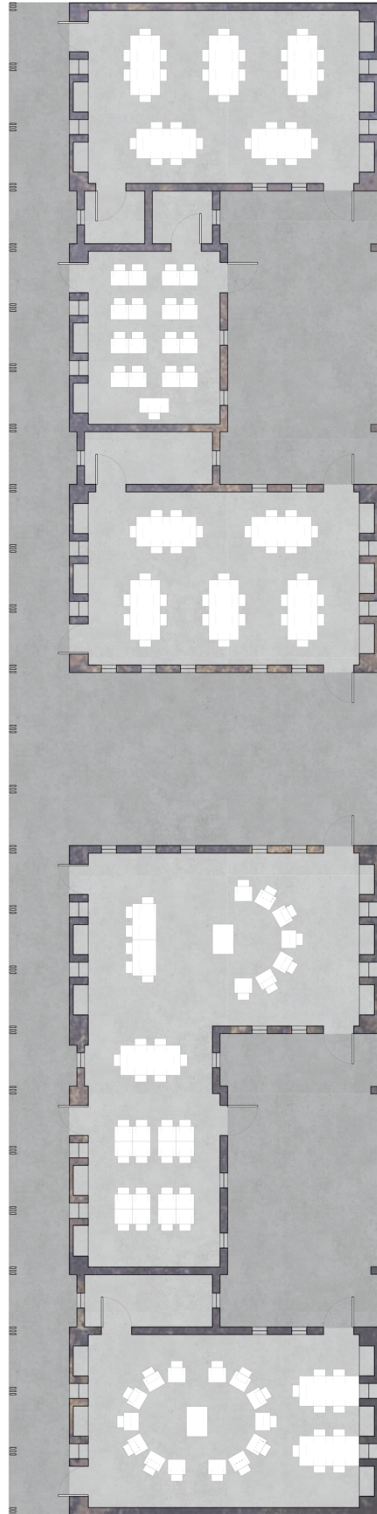
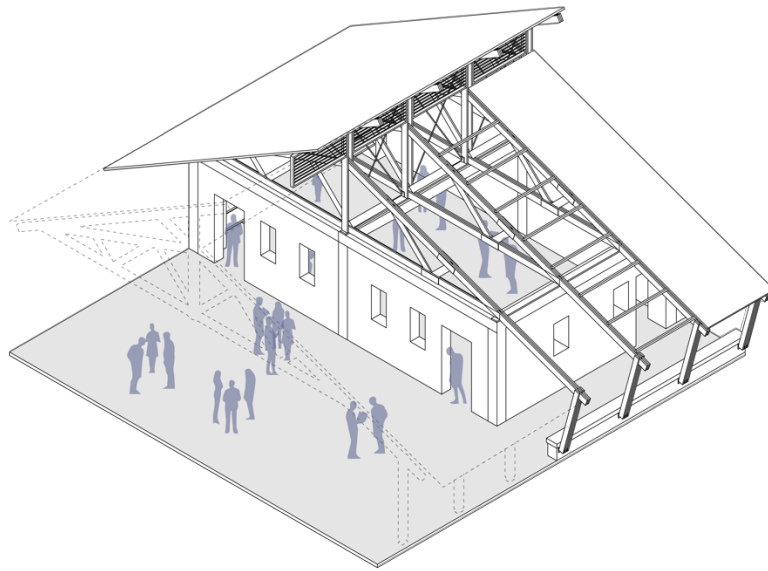


Figure 98: Larger Module - Library Floor Plan (by Author)



*Figure 99: Larger Module - Art Studio and Lab Floor Plan (by Author)*



*Figure 100: Larger Module - Outdoor Use of Space (by Author)*



*Figure 101: Larger Module - Library (by Author)*





*Figure 102: Community Courtyard (by Author)*



*Figure 103: Section Perspective in Classroom Courtyard (by Author)*

### Applicability:



The program can be rearranged and changed in size in order to fit varying needs of a community. If a site was located in a more rural, remote and new community, it may find itself needing less classrooms since there are less students attending the high

school and thus would only require having a minimum of 1 classroom per grade. This would create a program for about 80 students and because this school would be in a more removed area it would need to house all of its students in order to also address the commuting issues that the case study addressed. Because the school would be housing more students it would need to house more teachers as well. The dorm courtyard module could easily be replicated as many times as needed in order to fit the right amount of rooms for students and teachers as need, as long as the fixed dimensions of the courtyard itself remain the same.

If we take a look at the other extreme, the design for a school within a community that is already fully developed surround the site of the school, it would probably require even more classrooms. Within this scenario we could also imagine that because there are more people living within a more populated center less students would need to reside on campus. This would create a very minor change from the case study since all of the buildings that were arranged to house the dorms can now be used to house 10<sup>th</sup> and 11<sup>th</sup> graders, and have the Play zone separate these grades from the 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> graders, each group having their own courtyard. Within this setup each courtyard can have their own library.

## Chapter 9: Conclusion

The main issue that this thesis has hoped to deal with was designing a flexible model for a high school that can potentially serve and empower communities that are developing sustainably in Latin America. Some of the main issues addressed have been building appropriately to cultural/social and climatic conditions, designing spaces that can help celebrate teachers and make them feel excited about their profession, designing spaces that can accommodate a multitude of learning types, and most importantly designing buildable and flexible architecture. Through this design, the thesis aspires to provide a viable option for the quality educational infrastructure that the country is looking to provide to remote location through their educational reforms and initiatives.

Modular design is a way of creating flexible spaces that can be adapted to changing needs of a program and a community. This thesis intends to provide a way of tackling a set of issues that are prevalent in a large part of the Peruvian territory and in nature need to be adaptable. Even though this thesis attempted to resolve a set of issues within the case study of Satipo, many of the same issues are prevalent within the previously studied alternate sites and many of the other towns present within the region.

As long as the dimension of the modules and of the courtyards of this project are kept the same, the modules can easily be rearranged in order to meet many varying needs, whether that is as small of a change as where the storage goes, or as big as how many students need to attend the school. The flexibility provided by these modules helps create spaces that can ultimately empower communities through their ease of construction and adaptability.

Based on the design guidelines set forth by the Ministry of Education of Peru, the modules in this thesis would respect local building methods and provide a cultural awareness of all three of the climatic zones of the Peruvian Amazon, and with few alterations from site to site, can be suitable solutions for their educational needs.



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